Leica TS15
User Manual

Version 5.0
English

- when it has to be **right**

Leica Geosystems

Introduction

Purchase

Congratulations on the purchase of a Leica TS15.

This manual contains important safety directions as well as instructions for setting up the product and operating it. Refer to "1 Safety Directions" for further information. Read carefully through the User Manual before you switch on the product.

Product identification

The type and serial number of your product are indicated on the type plate.
Enter the type and serial number in your manual and always refer to this information when you need to contact your agency or Leica Geosystems authorised service workshop.

Type: _____

Serial No.: _____

Trademarks

- Windows is a registered trademark of Microsoft Corporation in the United States and other countries
- *Bluetooth*® is a registered trademark of Bluetooth SIG, Inc.
- SD Logo is a trademark of SD-3C, LLC.

All other trademarks are the property of their respective owners.

Validity of this manual

This manual applies to the TS15 instruments. Differences between the various models are marked and described.

Available documentation

Name	Description/Format		
TS15 Quick Guide	Provides an overview of the product together with technical data and safety directions. Intended as a quick reference guide.	✓	✓
TS15 User Manual	All instructions required in order to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions.	-	✓

Name	Description/Format		
Viva Series Technical Reference Manual	Overall comprehensive guide to the product and application functions. Included are detailed descriptions of special software/hardware settings and software/hardware functions intended for technical specialists.	-	✓

Refer to the following resources for all TS15 documentation/software:

- the Leica USB documentation card
- https://myworld.leica-geosystems.com

myWorld@Leica Geosystems (**https://myworld.leica-geosystems.com**) offers a wide range of services, information and training material.
With direct access to myWorld, you are able to access all relevant services whenever it is convenient for you, 24 hours a day, 7 days per week. This increases your efficiency and keeps you and your equipment instantly updated with the latest information from Leica Geosystems.

Service	Description
myProducts	Add all Leica Geosystems products that you and your company own. View detailed information on your products, buy additional options or Customer Care Packages (CCPs), update your products with the latest software and keep up-to-date with the latest documentation.
myService	View the service history of your products in Leica Geosystems Service Centres and detailed information on the services performed on your products. For your products that are currently in Leica Geosystems Service Centres view the current service status and the expected end date of service.
mySupport	Create new support requests for your products that will be answered by your local Leica Geosystems Support Team. View the complete history of your Support and view detailed information on each request in case you want to refer to previous support requests.
myTraining	Enhance your product knowledge with the Leica Geosystems Campus - Information, Knowledge, Training. Study the latest online training material or download training material on your products. Keep up-to-date with the latest News on your products and register for Seminars or Courses in your country.
myTrustedServices	Offers increased productivity while at the same time providing maximum security. • myExchange With myExchange you can exchange any files/objects from your computer to any of your Leica Exchange Contacts. • mySecurity If your instrument is ever stolen, a locking mechanism is available to ensure that the instrument is disabled and can no longer be used.

Table of Contents

In this manual

Chapter			Page
1	**Safety Directions**		**6**
	1.1	General Introduction	6
	1.2	Definition of Use	7
	1.3	Limits of Use	7
	1.4	Responsibilities	7
	1.5	Hazards of Use	8
	1.6	Laser Classification	10
	1.6.1	General	10
	1.6.2	Distancer, Measurements with Reflectors	10
	1.6.3	Distancer, Measurements without Reflectors	11
	1.6.4	Automatic Target Aiming ATR	12
	1.6.5	PowerSearch PS	13
	1.6.6	Electronic Guide Light EGL	14
	1.6.7	Laser Plummet	14
	1.6.8	Laser Guide	16
	1.7	Electromagnetic Compatibility EMC	17
	1.8	FCC Statement, Applicable in U.S.	19
2	**Description of the System**		**22**
	2.1	System Components	22
	2.2	System Concept	25
	2.2.1	Software Concept	25
	2.2.2	Power Concept	26
	2.2.3	Data Storage Concept	26
	2.3	Container Contents	27
	2.4	Instrument Components	31
3	**User Interface**		**34**
	3.1	Keyboard	34
	3.2	Operating Principles	35
4	**Operation**		**36**
	4.1	Setting Up the TPS Instrument	36
	4.2	Setting Up SmartStation	37
	4.3	Setting Up SmartPole	38
	4.4	Setting up for Remote Control (with the RadioHandle)	39
	4.5	Setting up for Remote Control (with the TCPS29)	39
	4.6	Fixing the CS to a Holder and Pole	41
	4.7	Connecting to a Personal Computer	43
	4.8	Power Functions	45
	4.9	Batteries	46
	4.9.1	Operating Principles	46
	4.9.2	Battery for the TS Instrument	46
	4.9.3	Battery for SmartAntenna	47
	4.10	Operating the Laser Guide	51
	4.11	Working with the Memory Device	51
	4.12	Working with the RTK Device (SmartStation)	53
	4.13	Working with the RTK Device	56
	4.14	LED Indicators	57
	4.15	Guidelines for Correct Results	61

5 Check & Adjust 62
5.1 Overview 62
5.2 Preparation 63
5.3 Combined Adjustment (l, t, i, c and ATR) 64
5.4 Tilting Axis Adjustment (a) 66
5.5 Adjusting the Circular Level of the Instrument and Tribrach 67
5.6 Adjusting the Circular Level of the Prism Pole 68
5.7 Inspecting the Laser Plummet of the Instrument 68
5.8 Adjusting the Laser Guide 69
5.9 Servicing the Tripod 71

6 Care and Transport 72
6.1 Transport 72
6.2 Storage 72
6.3 Cleaning and Drying 73
6.4 Maintenance 73

7 Technical Data 74
7.1 Angle Measurement 74
7.2 Distance Measurement with Reflectors 74
7.3 Distance Measurement without Reflectors 75
7.4 Distance Measurement - Long Range (LO mode) 76
7.5 Automatic Target Aiming ATR 76
7.6 PowerSearch PS 78
7.7 Overview Camera 78
7.8 SmartStation 79
7.8.1 SmartStation Accuracy 79
7.8.2 SmartStation Dimensions 79
7.8.3 SmartAntenna Technical Data 80
7.9 Laser Guide Technical Data 82
7.10 Conformity to National Regulations 83
7.10.1 TS15 83
7.10.2 RadioHandle 83
7.10.3 GS08plus 84
7.10.4 GS12 85
7.10.5 GS14 86
7.10.6 GS15 87
7.10.7 SLR1, SLR2, SATEL SATELLINE-3AS 88
7.10.8 SLR5, SATEL SATELLINE M3-TR1 89
7.10.9 SLR3-1, SLR3-2, Pacific Crest ADL 90
7.10.10 SLG1, Telit UC864-G 91
7.10.11 SLG2, CINTERION MC75i 92
7.10.12 SLC1 (US), SLC2 (US) CDMA Telit CC864-DUAL 93
7.11 General Technical Data of the Instrument 94
7.12 Scale Correction 97
7.13 Reduction Formulas 100

8 Software Licence Agreement 102

1 Safety Directions

1.1 General Introduction

Description

The following directions enable the person responsible for the product, and the person who actually uses the equipment, to anticipate and avoid operational hazards.

The person responsible for the product must ensure that all users understand these directions and adhere to them.

About Warning Messages

Warning messages are an essential part of the safety concept of the instrument. They appear wherever hazards or hazardous situations can occur.

Warning messages...

- make the user alert about direct and indirect hazards concerning the use of the product.
- contain general rules of behaviour.

For the users' safety, all safety instructions and safety messages shall be strictly observed and followed! Therefore, the manual must always be available to all persons performing any tasks described herein.

DANGER, **WARNING**, **CAUTION** and **NOTICE** are standardized signal words for identifying levels of hazards and risks related to personal injury and property damage. For your safety it is important to read and fully understand the table below with the different signal words and their definitions! Supplementary safety information symbols may be placed within a warning message as well as supplementary text.

Type	Description
⚠ **DANGER**	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
⚠ **WARNING**	Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.
⚠ **CAUTION**	Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor or moderate injury.
NOTICE	Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in appreciable material, financial and environmental damage.
☞	Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

1.2 Definition of Use

Intended use

- Measuring horizontal and vertical angles.
- Measuring distances.
- Recording measurements.
- Capturing and recording images.
- Automatic target search, recognition and -tracking.
- Visualising the aiming direction and vertical axis.
- Remote control of product.
- Data communication with external appliances.
- Measuring raw data and computing coordinates using carrier phase and code signal from GNSS satellites.
- Carrying out measurement tasks using various GNSS measuring techniques.
- Recording GNSS and point related data.
- Computing with software.

Reasonably foreseeable misuse

- Use of the product without instruction.
- Use outside of the intended use and limits.
- Disabling safety systems.
- Removal of hazard notices.
- Opening the product using tools, for example screwdriver, unless this is permitted for certain functions.
- Modification or conversion of the product.
- Use after misappropriation.
- Use of products with recognisable damages or defects.
- Use with accessories from other manufacturers without the prior explicit approval of Leica Geosystems.
- Inadequate safeguards at the working site.
- Aiming directly into the sun.

1.3 Limits of Use

Environment

Suitable for use in an atmosphere appropriate for permanent human habitation: not suitable for use in aggressive or explosive environments.

⚠ DANGER

Local safety authorities and safety experts must be contacted before working in hazardous areas, or close to electrical installations or similar situations by the person in charge of the product.

1.4 Responsibilities

Manufacturer of the product

Leica Geosystems AG, CH-9435 Heerbrugg, hereinafter referred to as Leica Geosystems, is responsible for supplying the product, including the user manual and original accessories, in a safe condition.

Person responsible for the product

The person responsible for the product has the following duties:

- To understand the safety instructions on the product and the instructions in the user manual.
- To ensure that it is used in accordance with the instructions.
- To be familiar with local regulations relating to safety and accident prevention.
- To inform Leica Geosystems immediately if the product and the application becomes unsafe.
- To ensure that the national laws, regulations and conditions for the operation of e.g. radio transmitters or lasers are respected.

1.5 Hazards of Use

CAUTION

Watch out for erroneous measurement results if the product has been dropped or has been misused, modified, stored for long periods or transported.

Precautions:

Periodically carry out test measurements and perform the field adjustments indicated in the user manual, particularly after the product has been subjected to abnormal use and before and after important measurements.

DANGER

Because of the risk of electrocution, it is dangerous to use poles and extensions in the vicinity of electrical installations such as power cables or electrical railways.

Precautions:

Keep at a safe distance from electrical installations. If it is essential to work in this environment, first contact the safety authorities responsible for the electrical installations and follow their instructions.

NOTICE

With the remote control of products, it is possible that extraneous targets will be picked out and measured.

Precautions:

When measuring in remote control mode, always check your results for plausibility.

WARNING

If the product is used with accessories, for example masts, staffs, poles, you may increase the risk of being struck by lightning.

Precautions:

Do not use the product in a thunderstorm.

WARNING

During dynamic applications, for example stakeout procedures there is a danger of accidents occurring if the user does not pay attention to the environmental conditions around, for example obstacles, excavations or traffic.

Precautions:

The person responsible for the product must make all users fully aware of the existing dangers.

WARNING

Inadequate securing of the working site can lead to dangerous situations, for example in traffic, on building sites, and at industrial installations.

Precautions:

Always ensure that the working site is adequately secured. Adhere to the regulations governing safety and accident prevention and road traffic.

CAUTION

Be careful when pointing the product towards the sun, because the telescope functions as a magnifying glass and can injure your eyes and/or cause damage inside the product.

Precautions:

Do not point the product directly at the sun.

CAUTION

If the accessories used with the product are not properly secured and the product is subjected to mechanical shock, for example blows or falling, the product may be damaged or people can sustain injury.

Precautions:

When setting-up the product, make sure that the accessories are correctly adapted, fitted, secured, and locked in position.

Avoid subjecting the product to mechanical stress.

CAUTION

During the transport, shipping or disposal of batteries it is possible for inappropriate mechanical influences to constitute a fire hazard.

Precautions:

Before shipping the product or disposing of it, discharge the batteries by running the product until they are flat.

When transporting or shipping batteries, the person in charge of the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping contact your local passenger or freight transport company.

WARNING

High mechanical stress, high ambient temperatures or immersion into fluids can cause leakage, fire or explosions of the batteries.

Precautions:

Protect the batteries from mechanical influences and high ambient temperatures. Do not drop or immerse batteries into fluids.

WARNING

If battery terminals are short circuited e.g. by coming in contact with jewellery, keys, metalized paper or other metals, the battery can overheat and cause injury or fire, for example by storing or transporting in pockets.

Precautions:

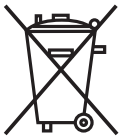
Make sure that the battery terminals do not come into contact with metallic objects.

WARNING

If the product is improperly disposed of, the following can happen:

- If polymer parts are burnt, poisonous gases are produced which may impair health.
- If batteries are damaged or are heated strongly, they can explode and cause poisoning, burning, corrosion or environmental contamination.
- By disposing of the product irresponsibly you may enable unauthorised persons to use it in contravention of the regulations, exposing themselves and third parties to the risk of severe injury and rendering the environment liable to contamination.

Precautions:



The product must not be disposed with household waste.

Dispose of the product appropriately in accordance with the national regulations in force in your country.

Always prevent access to the product by unauthorised personnel.

Product-specific treatment and waste management information can be downloaded from the Leica Geosystems home page at http://www.leica-geosystems.com/treatment or received from your Leica Geosystems dealer.

WARNING

Only Leica Geosystems authorised service workshops are entitled to repair these products.

1.6 Laser Classification

1.6.1 General

General

The following chapters provide instructions and training information about laser safety according to international standard IEC 60825-1 (2007-03) and technical report IEC TR 60825-14 (2004-02). The information enables the person responsible for the product and the person who actually uses the equipment, to anticipate and avoid operational hazards.

☞ According to IEC TR 60825-14 (2004-02), products classified as laser class 1, class 2 and class 3R do not require:

- laser safety officer involvement,
- protective clothes and eyewear,
- special warning signs in the laser working area

if used and operated as defined in this User Manual due to the low eye hazard level.

☞ National laws and local regulations could impose more stringent instructions for the safe use of lasers than IEC 60825-1 (2007-03) and IEC TR 60825-14 (2004-02).

1.6.2 Distancer, Measurements with Reflectors

General

The EDM module built into the product produces a visible laser beam which emerges from the telescope objective.

The laser product described in this section is classified as laser class 1 in accordance with:

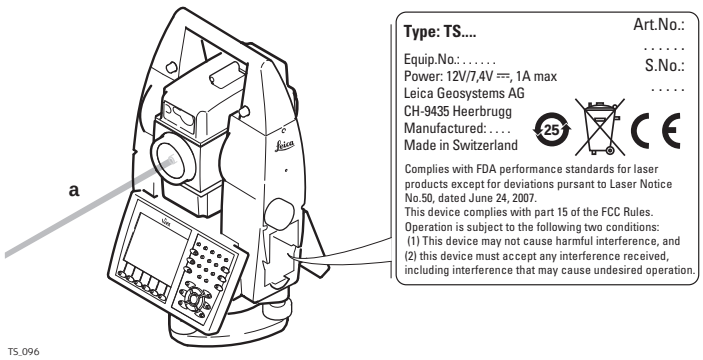
- IEC 60825-1 (2007-03): "Safety of laser products"
- EN 60825-1 (2007-10): "Safety of laser products"

These products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with this User Manual.

Description	Value
Maximum average radiant power	0.33 mW
Pulse duration	800 ps
Pulse repetition frequency (PRF)	100 MHz - 150 MHz
Wavelength	650 nm - 690 nm
Beam divergance	1.5 mrad x 3 mrad

Labelling

Class 1 Laser Product
according to IEC 60825-1
(2007 - 03)


a
Type: TS....
Art.No.:
Equip.No.:
S.No.:
Power: 12V/7,4V ⎓, 1A max
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured:
Made in Switzerland
Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No.50, dated June 24, 2007.
This device complies with part 15 of the FCC Rules.
Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.
TS_096

a) Laser beam

1.6.3 Distancer, Measurements without Reflectors

General

The EDM module built into the product produces a visible laser beam which emerges from the telescope objective.

The laser product described in this section is classified as laser class 3R in accordance with:

- IEC 60825-1 (2007-03): "Safety of laser products"
- EN 60825-1 (2007-10): "Safety of laser products"

Direct intrabeam viewing may be hazardous (low eye hazard level), in particular for deliberate ocular exposure. The beam may cause dazzle, flash-blindness and after-images, particularly under low ambient light conditions. The risk of injury for laser class 3R products is limited because of:

a) unintentional exposure would rarely reflect worst case conditions of (e.g.) beam alignment with the pupil, worst case accommodation,
b) inherent safety margin in the maximum permissible exposure to laser radiation (MPE)
c) natural aversion behaviour for exposure to bright light for the case of visible radiation.

Description	Value (R400/R1000)
Maximum average radiant power	5.00 mW
Pulse duration	800 ps
Pulse repetition frequency (PRF)	100 MHz - 150 MHz
Wavelength	650 nm - 690 nm
Beam divergence	0.2 mrad x 0.3 mrad
NOHD (Nominal Ocular Hazard Distance) @ 0.25s	80 m / 262 ft

CAUTION

From a safety perspective, class 3R laser products should be treated as potentially hazardous.

Precautions:

1) Prevent direct eye exposure to the beam.
2) Do not direct the beam at other people.

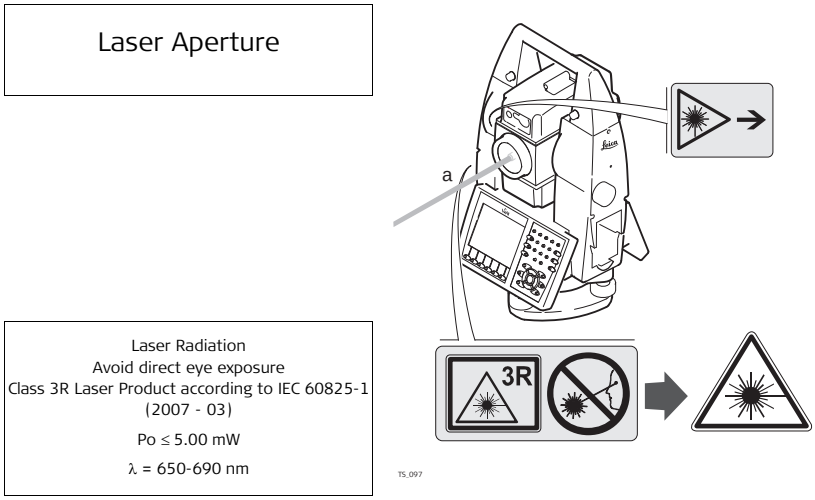
CAUTION

Potential hazards are not only related to direct beams but also to reflected beams aimed at reflecting surfaces such as prisms, windows, mirrors, metallic surfaces, etc.

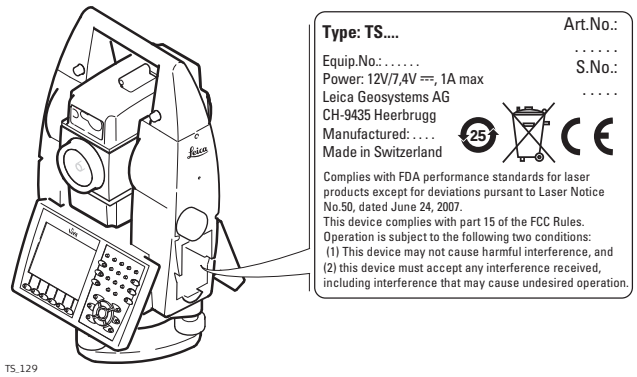
Precautions:

1) Do not aim at areas that are essentially reflective, such as a mirror, or which could emit unwanted reflections.
2) Do not look through or beside the optical sight at prisms or reflecting objects when the laser is switched on, in laser pointer or distance measurement mode. Aiming at prisms is only permitted when looking through the telescope.

Labelling



a) Laser beam


Type: TS....
Art.No.: .....
Equip.No.: .....
S.No.: .....
Power: 12V/7,4V ⎓, 1A max
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured: ....
Made in Switzerland
Complies with FDA performance standards for laser products except for deviations pursant to Laser Notice No.50, dated June 24, 2007.
This device complies with part 15 of the FCC Rules.
Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.
TS_129

1.6.4 Automatic Target Aiming ATR

General

The Automatic Target Aiming built into the product produces an invisible laser beam which emerges from the telescope objective.

The laser product described in this section is classified as laser class 1 in accordance with:

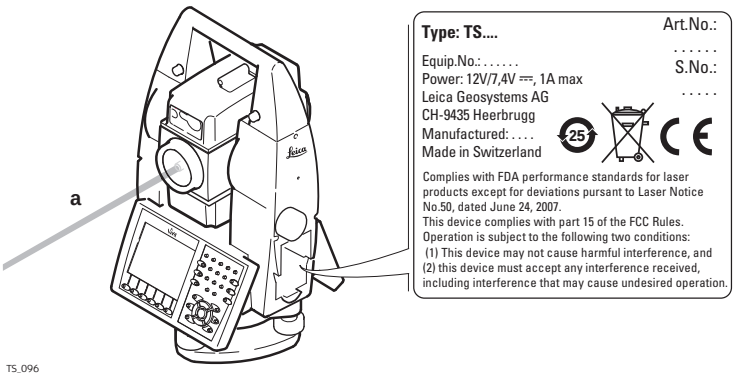
- IEC 60825-1 (2007-03): "Safety of laser products"
- EN 60825-1 (2007-10): "Safety of laser products"

These products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with this User Manual.

Description	Value
Maximum peak power	10 mW
Pulse duration	11 ms
Pulse repetition frequency (PRF)	37 Hz
Wavelength	785 nm

Labelling

Class 1 Laser Product
according to IEC 60825-1
(2007 - 03)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Type: TS....
Art.No.:
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Equip.No.:.....
S.No.:
.....
Power: 12V/7,4V ⎓, 1A max
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured:....
Made in Switzerland
25
Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No.50, dated June 24, 2007.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.
TS_096

a) Laser beam

1.6.5 PowerSearch PS

General

The PowerSearch built into the product produces an invisible laser beam which emerges from the front side of the telescope.

The laser product described in this section is classified as laser class 1 in accordance with:

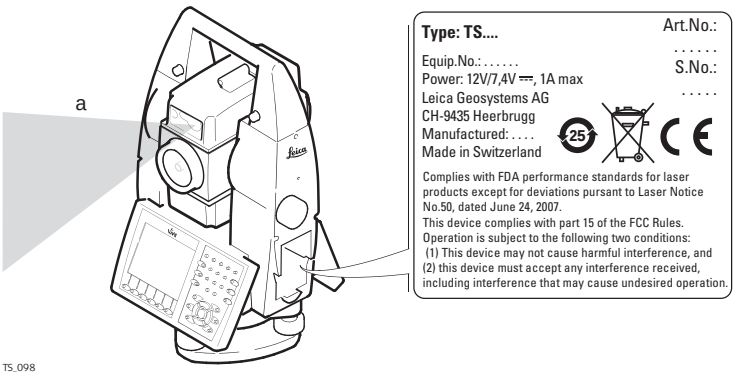
- IEC 60825-1 (2007-03): "Safety of laser products"
- EN 60825-1 (2007-10): "Safety of laser products"

These products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with this User Manual.

Description	Value
Wavelength	850 nm
Maximum average radiant power	11 mW
Pulse duration	20 ns, 40 ns
Pulse repetition frequency (PRF)	24.4 kHz
Beam divergance	0.4 mrad x 700 mrad

Labelling

Class 1 Laser Product
according to IEC 60825-1
(2007 - 03)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Type: TS....
Art.No.:
.....
Equip.No.:.....
S.No.:
.....
Power: 12V/7,4V ⎓, 1A max
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured:....
Made in Switzerland
25
Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No.50, dated June 24, 2007.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.
TS_098

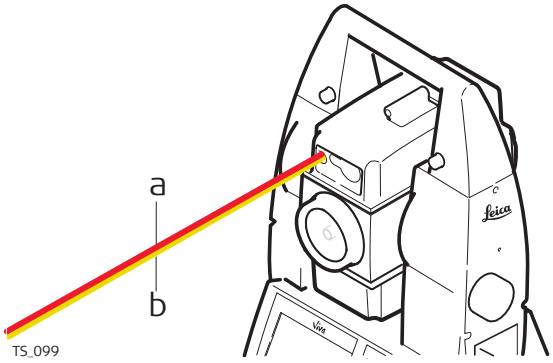
a) Laser beam

1.6.6 Electronic Guide Light EGL

General

The Electronic Guide Light built into the product produces a visible LED beam which emerges from the front side of the telescope.

The product described in this section, is excluded from the scope of IEC 60825-1 (2007-03): "Safety of laser products".
The product described in this section, is classified as exempt group in accordance with IEC 62471 (2006-07) and does not pose any hazard provided that the product is used and maintained in accordance with this user manual.



a) LED beam red
b) LED beam yellow

1.6.7 Laser Plummet

General

The laser plummet built into the product produces a visible red laser beam which emerges from the bottom of the product.

The laser product described in this section is classified as laser class 2 in accordance with:

- IEC 60825-1 (2007-03): "Safety of laser products"
- EN 60825-1 (2007-10): "Safety of laser products"

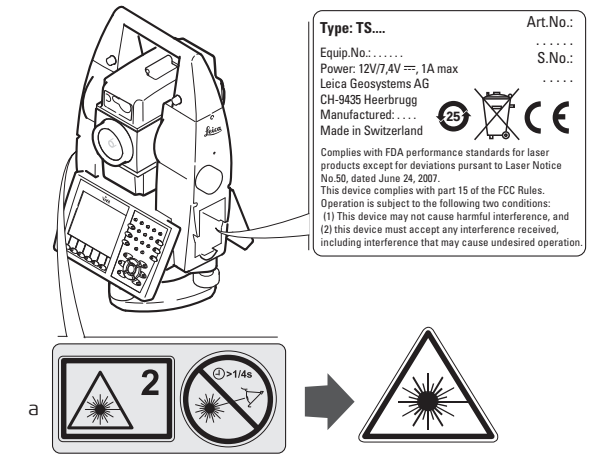
These products are safe for momentary exposures but can be hazardous for deliberate staring into the beam. The beam may cause dazzle, flash-blindness and after-images, particularly under low ambient light conditions.

Description	Value
Wavelength	650 nm - 690 nm
Maximum average radiant power	0.95 mW
Pulse duration	c.w.
Pulse repetition frequency (PRF)	c.w.
Beam divergance	< 1.5 mrad

CAUTION

From a safety perspective, class 2 laser products are not inherently safe for the eyes.
Precautions:
1) Avoid staring into the beam.
2) Avoid pointing the beam at other people.

Labelling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Art.No.:
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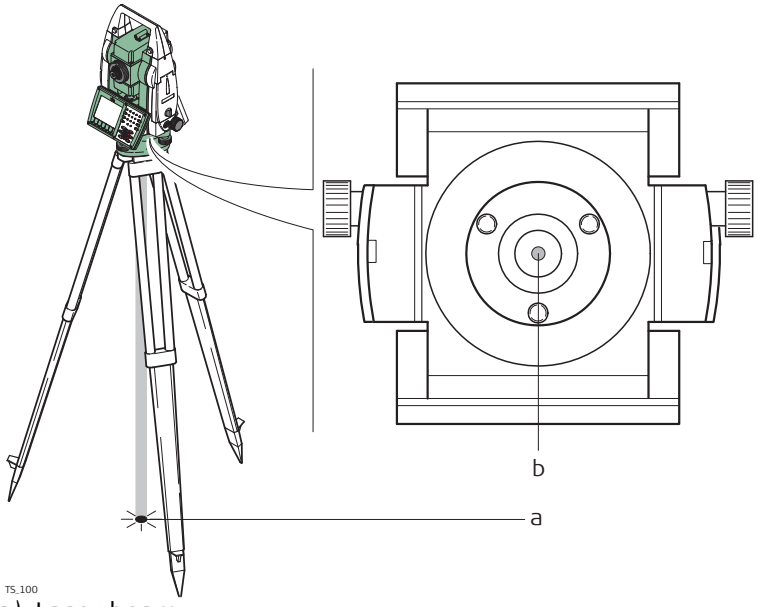
Equip.No.: . . . . . .
S.No.:
. . . . .
Power: 12V/7,4V ⎓, 1A max
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured: . . . .
Made in Switzerland
Complies with FDA performance standards for laser products except for deviations pursant to Laser Notice No.50, dated June 24, 2007.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.
a
2
>1/4s
TS_117

Laser Radiation
Do not stare into the beam
Class 2 Laser Product
according to IEC 60825-1
(2007 - 03)

Po ≤ 1.00 mW

λ = 620 - 690 nm

a) Will be replaced by a class 3R warning label if applicable



a) Laser beam
b) Exit for laser beam

1.6.8 Laser Guide

General

The Laser Guide built into the TS15 G instrument produces a visible red laser beam which emerges from the front side of the telescope.

The laser product described in this section is classified as laser class 3R in accordance with:

- IEC 60825-1 (2007-03): "Safety of laser products"
- EN 60825-1 (2007-10): "Safety of laser products"

Direct intrabeam viewing may be hazardous (low eye hazard level), in particular for deliberate ocular exposure. The beam may cause dazzle, flash-blindness and after-images, particularly under low ambient light conditions. The risk of injury for laser class 3R products is limited because of:

a) unintentional exposure would rarely reflect worst case conditions of (e.g.) beam alignment with the pupil, worst case accommodation,
b) inherent safety margin in the maximum permissible exposure to laser radiation (MPE)
c) natural aversion behaviour for exposure to bright light for the case of visible radiation.

Description	Value (R400/R1000)
Maximum radiant power	4.75 mW
Pulse duration	c.w.
Pulse repetition frequency	c.w.
Wavelength	650 nm - 690 nm
Beam divergence	0.1 mrad
NOHD (Nominal Ocular Hazard Distance) @ 0.25s	112 m / 367 ft

CAUTION

From a safety perspective, class 3R laser products should be treated as potentially hazardous.

Precautions:

1) Prevent direct eye exposure to the beam.
2) Do not direct the beam at other people.

CAUTION

Potential hazards are not only related to direct beams but also to reflected beams aimed at reflecting surfaces such as prisms, windows, mirrors, metallic surfaces, etc.

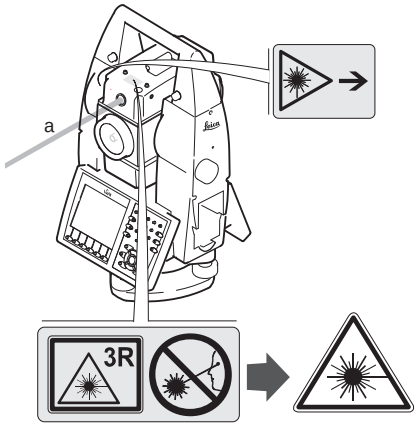
Precautions:

1) Do not aim at areas that are essentially reflective, such as a mirror, or which could emit unwanted reflections.
2) Do not look through or beside the optical sight at prisms or reflecting objects when the laser is switched on, in laser pointer or distance measurement mode. Aiming at prisms is only permitted when looking through the telescope.

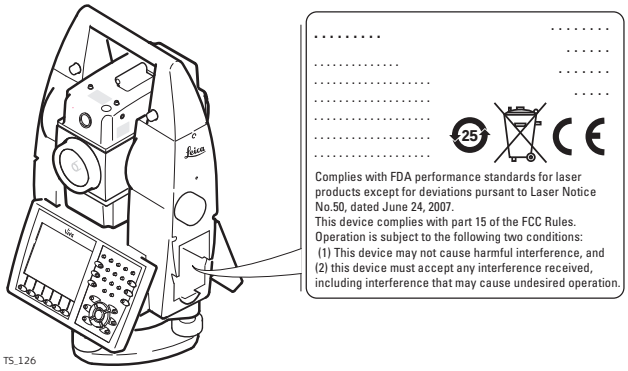
Labelling

Laser Aperture

Laser Radiation
Avoid direct eye exposure
Class 3R Laser Product according to IEC 60825-1
(2007 - 03)
Po ≤ 4.75 mW
λ = 650-690 nm



a) Laser beam


Complies with FDA performance standards for laser products except for deviations pursant to Laser Notice No.50, dated June 24, 2007.
This device complies with part 15 of the FCC Rules.
Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.
TS_126

1.7 Electromagnetic Compatibility EMC

Description

The term Electromagnetic Compatibility is taken to mean the capability of the product to function smoothly in an environment where electromagnetic radiation and electrostatic discharges are present, and without causing electromagnetic disturbances to other equipment.

WARNING

Electromagnetic radiation can cause disturbances in other equipment.

Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment may be disturbed.

CAUTION

There is a risk that disturbances may be caused in other equipment if the product is used with accessories from other manufacturers, for example field computers, personal computers or other electronic equipment, non-standard cables or external batteries.

Precautions:

Use only the equipment and accessories recommended by Leica Geosystems. When combined with the product, they meet the strict requirements stipulated by the guidelines and standards. When using computers or other electronic equipment, pay attention to the information about electromagnetic compatibility provided by the manufacturer.

CAUTION

Disturbances caused by electromagnetic radiation can result in erroneous measurements.
Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that the product may be disturbed by intense electromagnetic radiation, for example, near radio transmitters, two-way radios or diesel generators.
Precautions:
Check the plausibility of results obtained under these conditions.

CAUTION

If the product is operated with connecting cables attached at only one of their two ends, for example external supply cables, interface cables, the permitted level of electromagnetic radiation may be exceeded and the correct functioning of other products may be impaired.
Precautions:
While the product is in use, connecting cables, for example product to external battery, product to computer, must be connected at both ends.

Radios or digital cellular phones

WARNING

Use of product with radio or digital cellular phone devices:

Electromagnetic fields can cause disturbances in other equipment, in installations, in medical devices, for example pacemakers or hearing aids and in aircraft. It can also affect humans and animals.
Precautions:
Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment can be disturbed or that humans or animals can be affected.

- Do not operate the product with radio or digital cellular phone devices in the vicinity of filling stations or chemical installations, or in other areas where an explosion hazard exists.
- Do not operate the product with radio or digital cellular phone devices near to medical equipment.
- Do not operate the product with radio or digital cellular phone devices in aircraft.

1.8 FCC Statement, Applicable in U.S.

The greyed paragraph below is only applicable for products without radio.

WARNING

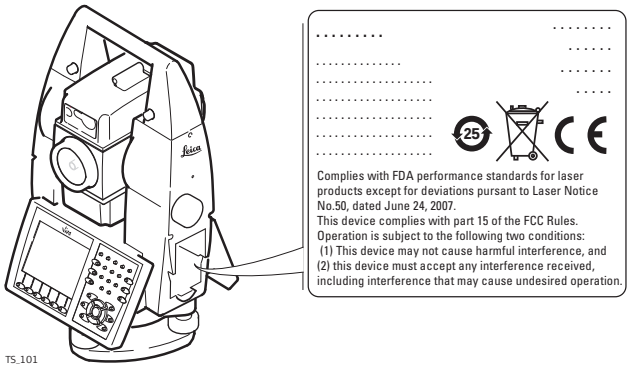
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules.
These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

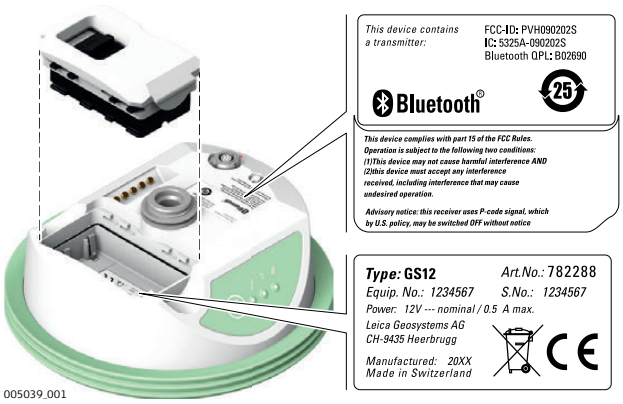
WARNING

Changes or modifications not expressly approved by Leica Geosystems for compliance could void the user's authority to operate the equipment.

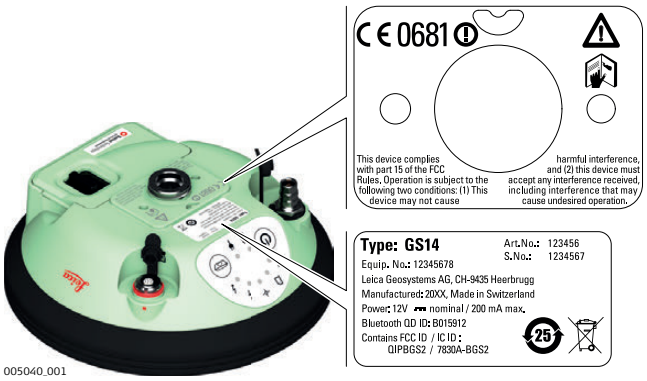
Labelling TS15


Complies with FDA performance standards for laser products except for deviations pursant to Laser Notice No.50, dated June 24, 2007.
This device complies with part 15 of the FCC Rules.
Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.
TS_101

Labelling GS08plus, GS12


This device contains a transmitter:
FCC-ID: PVH090202S
IC: 5325A-090202S
Bluetooth QPL: B02690
Bluetooth
This device complies with part 15 of the FCC Rules.
Operation is subject to the following two conditions:
(1)This device may not cause harmful interference AND
(2)this device must accept any interference received, including interference that may cause undesired operation.
Advisory notice: this receiver uses P-code signal, which by U.S. policy, may be switched OFF without notice
Type: GS12
Art.No.: 782288
Equip. No.: 1234567
S.No.: 1234567
Power: 12V --- nominal / 0.5 A max.
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured: 20XX
Made in Switzerland
005039_001

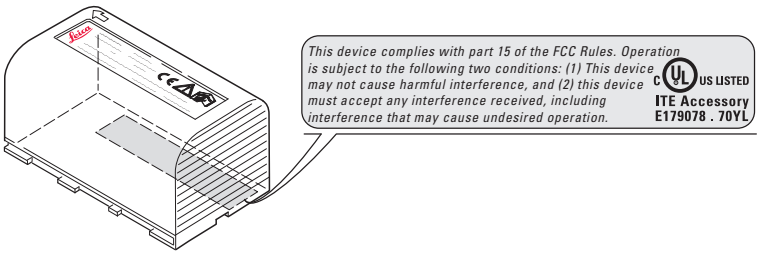
Labelling GS14


CE 0681
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
Type: GS14
Art.No.: 123456
S.No.: 1234567
Equip. No.: 12345678
Leica Geosystems AG, CH-9435 Heerbrugg
Manufactured: 20XX, Made in Switzerland
Power: 12V nominal / 200 mA max.
Bluetooth QD ID: B015912
Contains FCC ID / IC ID:
QIPBGS2 / 7830A-BGS2
25
005040_001

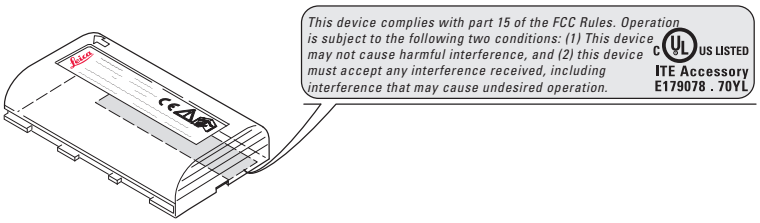
Labelling GS15

Type: GS15
S.No.: 1234567
Equi.No.: 1234567
Art.No.: 7XXXXX
Power: 12V nominal 0.5 A max.
CE 0681
Leica Geosystems AG
CH-9435 Heerbrugg
IC: 6850A-31308
Contains transmitter module:
Manufactured: 20XX
Made in Switzerland
FCC-ID: Q231308
Bluetooth QD ID: B015912
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
25
202WW105669723
005041_001

Labelling internal battery GEB222

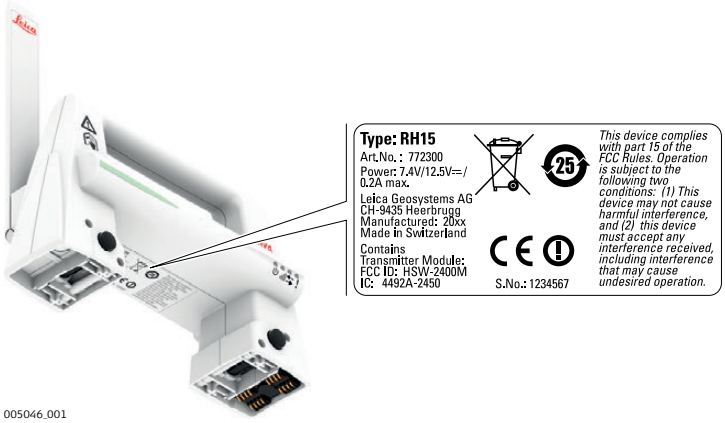

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
C UL US LISTED
ITE Accessory
E179078 . 70YL
GEB_002

Labelling internal battery GEB211, GEB212


This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
C UL US LISTED
ITE Accessory
E179078 . 70YL
GEB_001

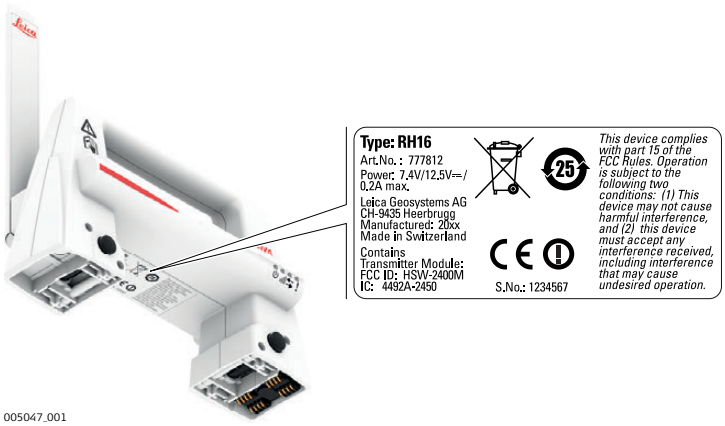
Labelling RadioHandle

RH15


Type: RH15
Art.No. : 772300
Power: 7.4V/12.5V⎓/
0.2A max.
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured: 20xx
Made in Switzerland
Contains
Transmitter Module:
FCC ID: HSW-2400M
IC: 4492A-2450
S.No.: 1234567
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

005046_001

RH16

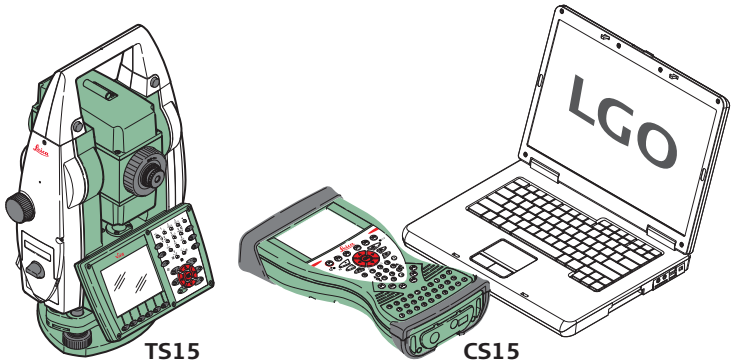

Type: RH16
Art.No. : 777812
Power: 7.4V/12.5V⎓/
0.2A max.
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured: 20xx
Made in Switzerland
Contains
Transmitter Module:
FCC ID: HSW-2400M
IC: 4492A-2450
S.No.: 1234567
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

005047_001

2 Description of the System

2.1 System Components

System components



003962_001

General description

TS15 is a collective term describing total stations of the Leica Viva Series.

Main components

Component	Description
TS15 instrument	• a total station for measuring, calculating and capturing data. • consisting of various models with a range of accuracy classes. • integrated with an add-on GNSS system to form Smart-Station. • combined with the multi-purpose CS10/CS15 field controller to conduct remote control surveys.
Laser Guide	• a variant of the TS15 instrument equipped with Automatic Target Aiming. Instruments equipped with the Laser Guide cannot be equipped with PowerSearch (PS) or Guide Light (EGL). • included in a special compartment in the upper telescope section. • emits a visible red laser beam used for visualising the line of sight. • used for guiding tunnel boring machines, monitoring tunnelling progress or visualising bore holes for rock blasting; targeting of inaccessible objects or prohibited surfaces; positioning of objects and inspecting marks on surfaces.
CS10/CS15 field controller	A multipurpose field controller enabling the remote control of the TS15 instrument.
Leica Geo Office/Infinity	The office software including a series of help programs which support working with Leica Viva Series instruments.

Terms and abbreviations

The following terms and abbreviations can be found in this manual:

Term	Description
RCS	**R**emote **C**ontrol **S**urveying
EDM	**E**lectronic **D**istance **M**easurement EDM refers to the laser distancer incorporated into the instrument which enables distance measurement. Two measuring modes are available: • **Prism** mode. This mode refers to the ability to measure distances to prisms. It incorporates the **LO** mode to measure extended distances to prisms. • **Any surface** mode. This mode refers to the ability to measure distances without prisms.
PinPoint	PinPoint refers to the Reflectorless EDM technology which enables an increased measuring range with a smaller laser spot size. Three options are available: R30, R400 and R1000.
EGL	**E**lectronic **G**uide **L**ight An EGL fitted to an instrument assists with prism targeting. It consists of two differently coloured flashing lights located in the instrument telescope housing. The person holding the prism can align themselves into the line-of-sight of the instrument.
Motorised	Instruments fitted with internal motors, enabling automatic horizontal and vertical turning are referred to as **M**otorised.
ATR	Automated Target Aiming. ATR refers to the instrument sensor which enables the automatic target aiming to a prism.
Automated	Instruments fitted with Target aiming are referred to as **A**utomated. Target aiming refers to the instrument sensor which enables the automatic target aiming to a prism. Three automation modes are available with Target aiming: • Manual: no Target aiming - no automation and no lock. • Automatic: automatic target aiming to a prism. • LOCK: automatic tracking of an already targeted prism.
Overview camera	Overview camera is located in the upper part of the telescope housing and has a fixed focus without optical magnification.
PowerSearch	**P**ower**S**earch refers to the instrument sensor which enables the automatic rapid finding of a prism.
SmartStation	A Leica Viva TPS instrument integrated with an add-on GNSS system, comprising hardware and software components, forms a SmartStation. Components of a SmartStation include a SmartAntenna and a SmartAntenna Adapter. A SmartStation provides an additional instrument setup method for determining instrument station coordinates. The GNSS principles and functionality of a SmartStation derive from the principles and functionality of Leica Viva GNSS instruments.

Term	Description
SmartAntenna	SmartAntenna with integrated Bluetooth is a component of a SmartStation. It can also be used independently on a pole with a CS10/CS15 field controller. Models compatible with a TS15 instrument are GS12/GS14/GS15. Where there are differences between the various models they are clearly described.
RadioHandle	A component of RCS is the RH15/RH16 RadioHandle. It is an instrument carry handle with an integrated radio modem with attached antenna.
Communication side cover	Communication side cover with integrated Bluetooth, SD card slot and USB port is standard for a TS15 instrument and a component of a SmartStation. In combination with the RH15/RH16 RadioHandle, it is also a component of RCS.

Available models

Model	TS15 M	TS15 A	TS15 G	TS15 P	TS15 I
Angle measurement	✓	✓	✓	✓	✓
Distance measurement to prism	✓	✓	✓	✓	✓
Distance measurement to any surface (reflectorless)	✓	✓	✓	✓	✓
Motorised	✓	✓	✓	✓	✓
Automatic Target Aiming	-	✓	✓	✓	✓
PowerSearch (PS)	-	-	-	✓	✓
Overview Camera	-	-	-	-	✓
RS232, USB and SD card interface	✓	✓	✓	✓	✓
Bluetooth	✓	✓	✓	✓	✓
Internal Flash Memory (1 GB)	✓	✓	✓	✓	✓
Hotshoe interface for RadioHandle	✓	✓	✓	✓	✓
Guide Light (EGL)	✓	✓	-	✓	✓
Laser Guide	-	-	✓	-	-

✓Standard - Not available

2.2 System Concept

2.2.1 Software Concept

Description

All instruments use the same software concept.

Software for TS models

Software type	Description
TS firmware (TS_xx.fw)	This important software covers all functions of the instrument. The applications Survey and Setup are integrated into the firmware and cannot be deleted. The English language is integrated into the firmware and cannot be deleted.
Language software (SYS_LANG.sxx)	Numerous languages are available for the TS instruments. This software is also referred to as system language. The English language is the default language. One language is chosen as the active language.
Applications (xx.axx)	Many optional survey-specific applications are available for the TS instruments. Some of the applications are activated freely and require no licence key, and others require purchasing and are only activated with a licence key. Applications requiring an activation run for a 180 days trial period without prior activation.
Customised applications (xx.axx)	Customised software, specific to user requirements, can be developed using the GeoC++ development kit in addition to run Windows CE-based applications if GeoCOM robotics licence is available. Information on the GeoC++ development environment is available on request from a Leica Geosystems representative.

Software upload

☞ Uploading software can take some time. Ensure that the battery is at least 75% full before beginning the upload, and do not remove the battery during the upload process.

Software for	Description
All TS models	The SmartWorx Viva is stored in the flash RAM of the TS instrument. **Software update instructions** • Download the most recent TS firmware file from https://myworld.leica-geosystems.com. Refer to "Introduction". • Connect the TS instrument to your PC. Refer to "4.7 Connecting to a Personal Computer". • Copy the TS firmware file onto a folder system on the Leica SD card. • Start the TS instrument. In SmartWorx Viva select **User\Tools & other utilities\Load firmware & Apps**. Select **Object to transfer: Firmware**. • A message will appear when the upload is complete.

2.2.2 Power Concept

General

Use the batteries, chargers and accessories recommended by Leica Geosystems to ensure the correct functionality of the instrument.

Power options

Model	Power supply
all TS models	Internally by GEB221/GEB222 battery, OR Externally by GEV52 cable and GEB171 battery. If an external power supply is connected and the internal battery is inserted, then the external power is used.
SmartAntenna	Internally via GEB211/GEB212 battery fitted into the antenna.

2.2.3 Data Storage Concept

Description

Data is stored on a memory device. The memory device can be an SD card or internal memory. For data transfer an USB stick can also be used.

Memory device

SD card: All instruments have an SD card slot fitted as standard. An SD card can be inserted and removed. Available capacity: 8 GB.

USB stick: All instruments have a USB port fitted as standard.

Internal memory: All instruments have an internal memory fitted as standard. Available capacity: 1 GB.

☞ While other SD cards can be used, Leica Geosystems recommends to only use Leica SD cards and is not responsible for data loss or any other error that can occur while using a non-Leica card.

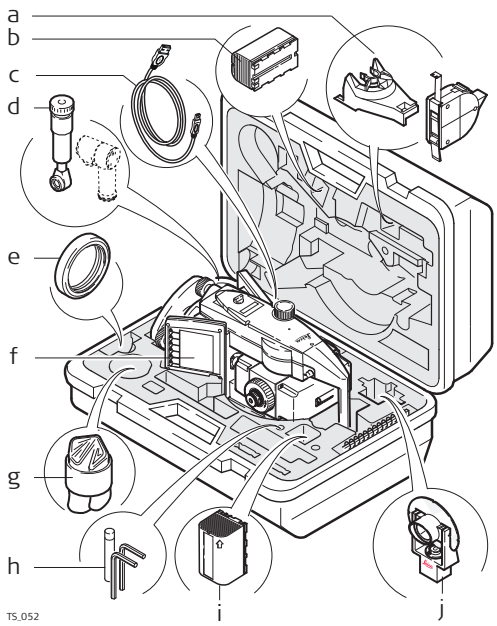
☞ Unplugging connecting cables or removing the SD card or USB stick during the measurement can cause loss of data. Only remove the SD card or USB stick or unplug connecting cables when the TS instrument is switched off.

Transfer data

Data can be transferred in various ways. Refer to "4.7 Connecting to a Personal Computer".

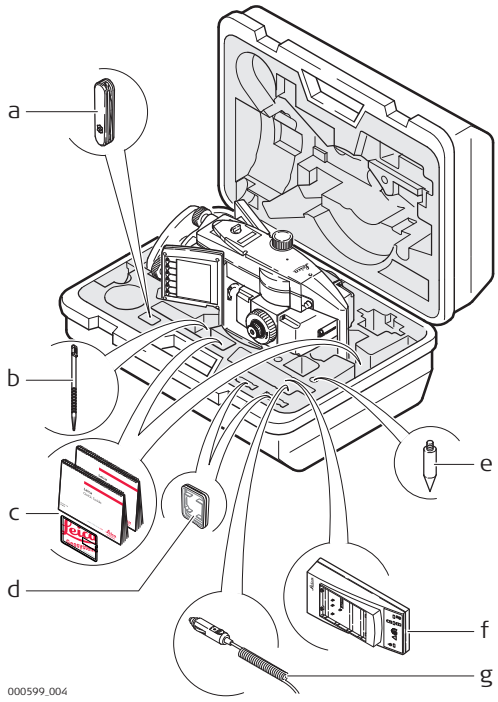
☞ SD cards can directly be used in an OMNI drive as supplied by Leica Geosystems. Other PC card drives can require an adaptor.

Container for instrument and accessories part 1 of 2



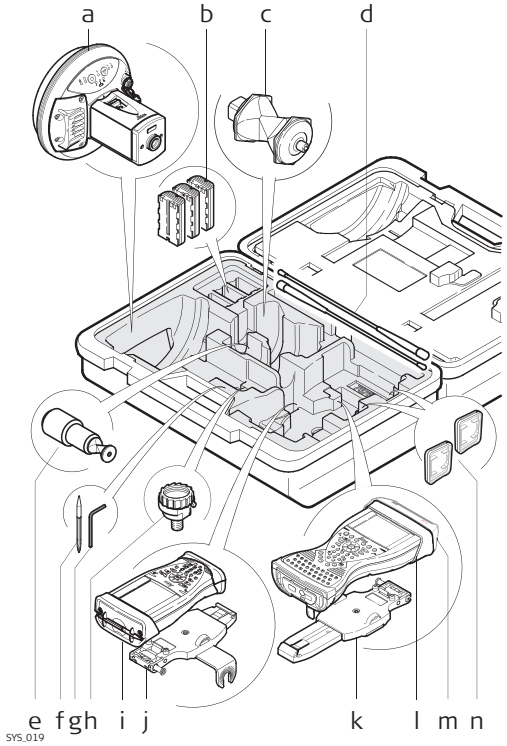
a) GHM007 Instrument height meter and GHT196 tribrach bracket for height meter
b) GEB221/GEB222 battery
c) Data transfer cable
d) GFZ3 or GOK6 diagonal eyepiece
e) Counterweight for diagonal eyepiece
f) Instrument with tribrach and standard handle or RadioHandle
g) Protective cover for instrument, sunshade for objective lens and cleaning cloth
h) Allen key
i) GEB221/GEB222 battery
j) GMP101 mini prism

Container for instrument and accessories part 2 of 2



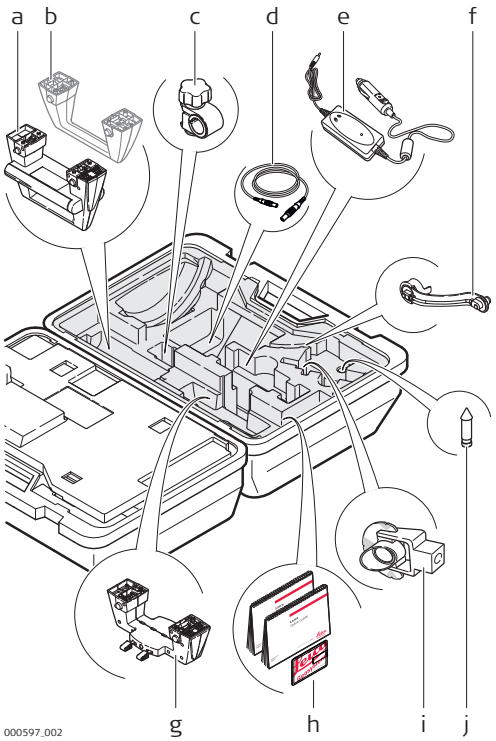
a) Pocket knife*
b) Spare stylus
c) Manuals & USB documentation card
d) SD cards/CompactFlash cards and covers
e) Tip for mini prism
f) GKL211 battery charger
g) Car adapter power plug for battery charger (stored under battery charger)
* Optional

Container for GS15 SmartPole/ SmartStation and accessories part 1 of 2



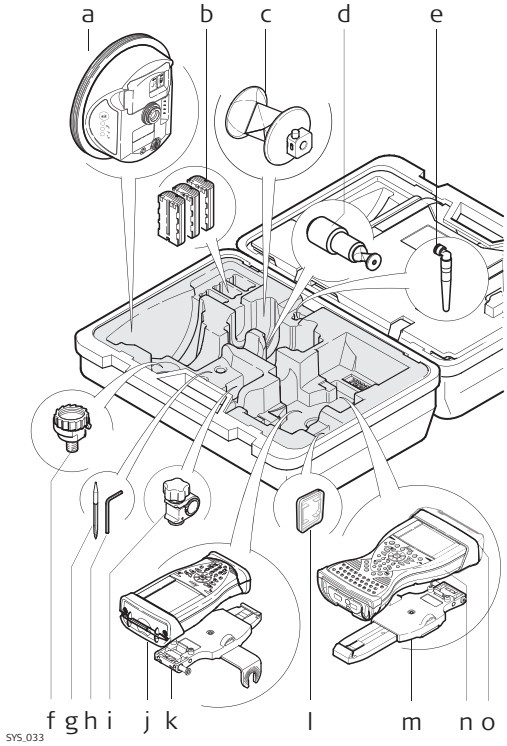
a) GS15 antenna
b) GEB211/GEB212 batteries
c) GRZ4/GRZ122 prism
d) Radio antennas
e) GRZ101 mini prism and GAD103 adapter
f) Spare stylus
g) Allen key
h) GAD31 adapter
i) CS10 field controller
j) GHT62 holder
k) GHT62 holder (extended)
l) CS15 field controller
m) CTR16 radio cap
n) SD card / CompactFlash card and covers

Container for GS15 SmartPole/ SmartStation and accessories part 2 of 2



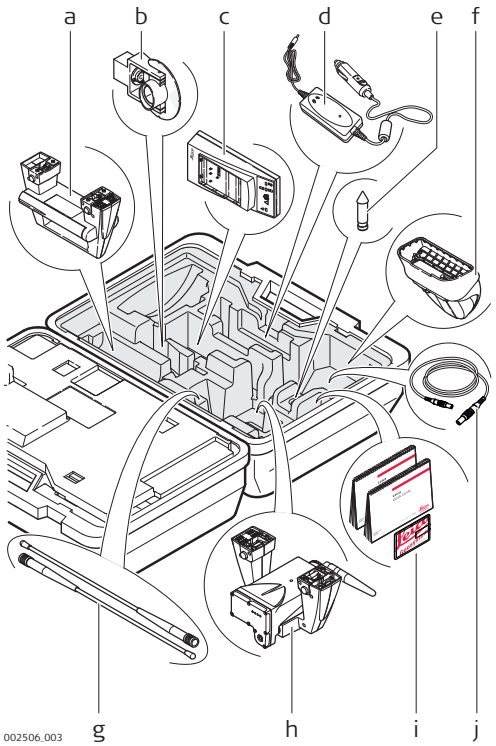
a) RadioHandle
b) Instrument carry handle
c) GHT63 clamp
d) Cables
e) GDC221 car adapter for CS field controller
f) GAD108 arm
g) GAD110 adapter for GS15 antenna
h) Manuals & USB documentation card
i) GMP101 mini prism
j) Mini prism spike

Container for GS08plus/GS12/ GS14 SmartPole/ SmartStation and accessories part 1 of 2



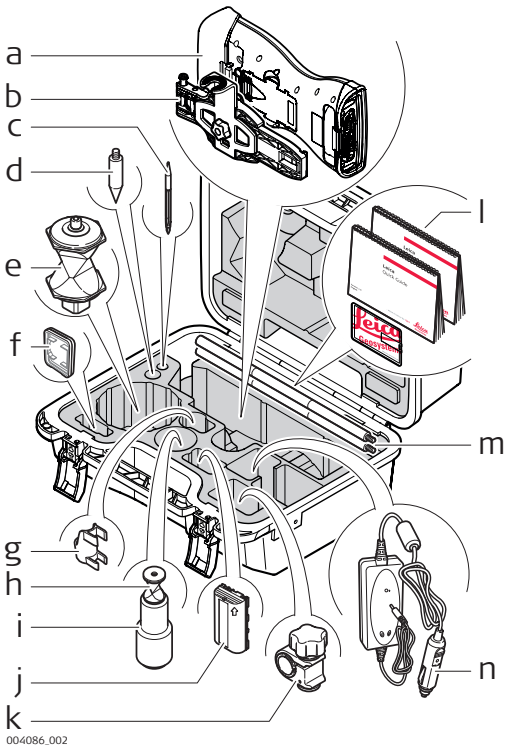
a) GS08plus/GS12/GS14 antenna
b) GEB211/GEB212 battery
c) GRZ4/GRZ122 prism
d) GRZ101 mini prism and GAD103 adapter
e) GAT21 antenna
f) GAD31 adapter
g) Spare stylus
h) Allen key
i) GHT63 clamp
j) CS10 field controller
k) GHT62 holder
l) SD card/CompactFlash card and covers
m) GHT62 holder (extended)
n) CS15 field controller
o) CTR16 radio cap

Container for GS08plus/GS12/ GS14 SmartPole/ SmartStation and accessories part 2 of 2



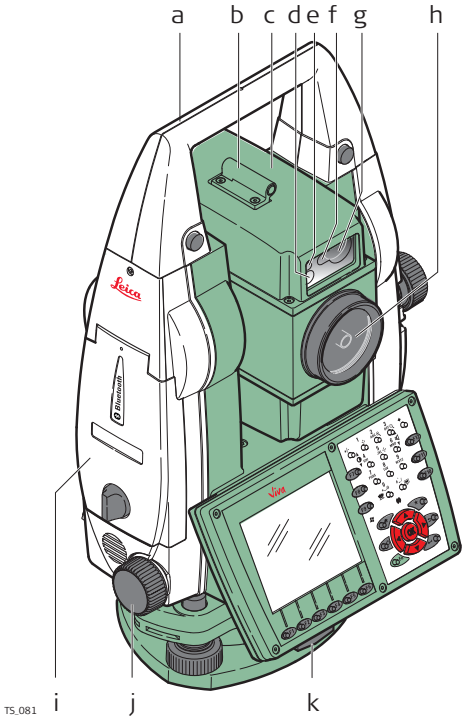
a) RadioHandle
b) GMP101 mini prism
c) GKL211 battery charger
d) GDC221 car adapter for CS field controller
e) Mini prism spike
f) CGR10/CGR15 radio
g) Radio antenna
h) GAD104 adapter for GS12 antenna or GAD110 adapter for GS08plus/GS14 instrument
i) Manuals & USB documentation card
j) Cables

Container for TPS robotic pole setup, small size



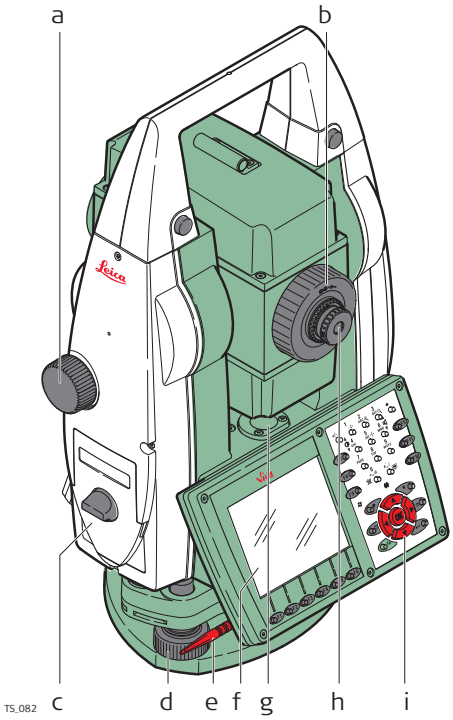
a) CS15 field controller with CTR16
b) GHT62 holder (extended)
c) Spare stylus
d) Tip for mini pole
e) GRZ4/GRZ122 prism
f) CompactFlash card/SD card
g) GLI115, clip-on bubble for mini pole
h) GRZ101 mini prism
i) GAD103 adapter for GRZ101 mini prism
j) GEB211/GEB212 battery
k) GHT63 clamp
l) Manuals & USB documentation card
m) GLS115 mini pole
n) GDC221 car adapter for CS field controller

Instrument components part 1 of 2



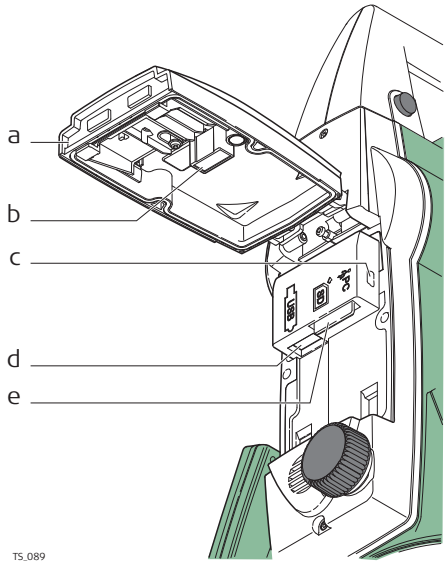
a) Carry handle
b) Optical sight
c) Telescope, integrating EDM, ATR, EGL, PS, overview camera
d) EGL flashing diode - yellow and red
e) Overview camera, lens
f) PowerSearch, transmitter
g) PowerSearch, receiver
h) Coaxial optics for angle and distance measurement, and exit port of visible laser beam for distance measurements
i) Communication side cover
j) Horizontal drive
k) Tribrach securing screw

Instrument components part 2 of 2



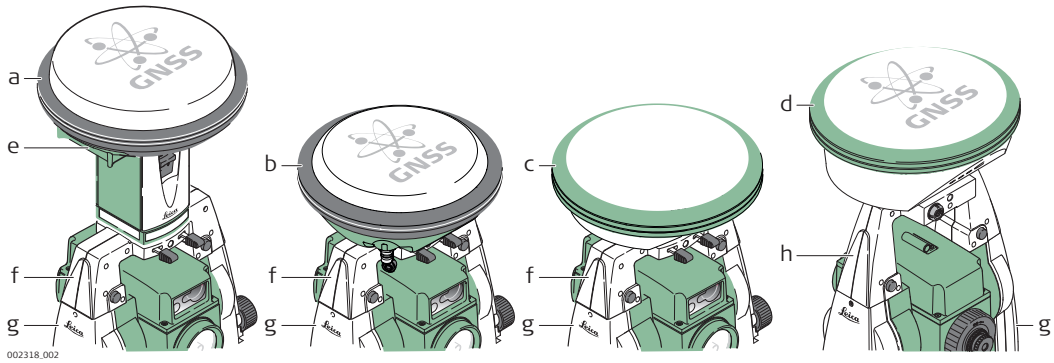
a) Vertical drive
b) Focusing ring
c) Battery compartment
d) Tribrach footscrew
e) Stylus for touch screen
f) Touch screen
g) Circular level
h) Interchangeable eyepiece
i) Keyboard

Communication side cover



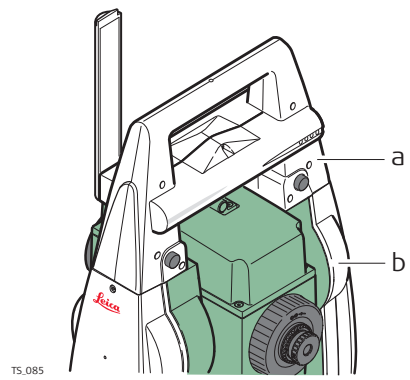
a) Compartment lid
b) USB stick cap storage
c) USB device port (mini AB OTG)
d) USB host port for USB stick
e) SD card port

Instrument components for SmartStation



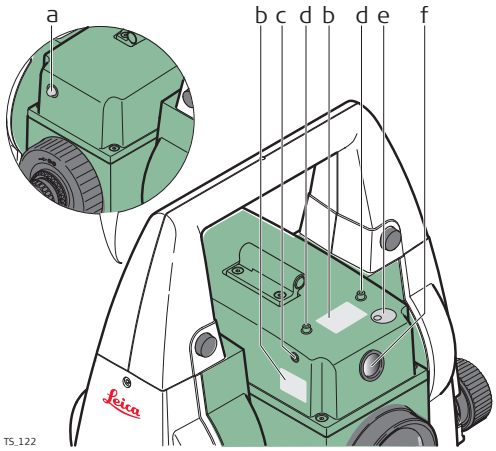
a) GS15
b) GS14
c) GS08plus
d) GS12
e) RTK slot-in device
f) GAD110 SmartAntenna Adapter
g) Communication side cover
h) GAD104 SmartAntenna Adapter

Instrument components for RCS



a) RadioHandle
b) Communication side cover

Laser guide components

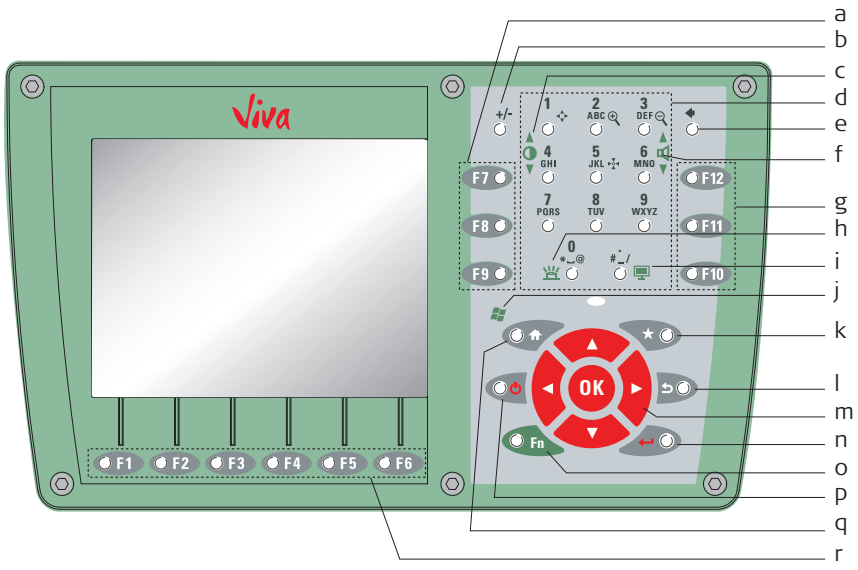


a) Operation indicator LED, orange
b) Labelling
c) Horizontal adjustment screws
d) Fixing screws
e) Safety cover for vertical adjustment screws
f) Laser aperture

3 User Interface

3.1 Keyboard

Keyboard



TS_087

a) Function keys **F7** - **F9**
b) ± key
c) Brightness
d) Alphanumeric keys
e) Backspace
f) Volume
g) Function keys **F10** - **F12**
h) Keyboard illumination
i) Screenshot
j) Windows CE
k) Favourites
l) ESC
m) Arrow keys, **OK**
n) ENTER
o) **Fn**
p) ON/OFF
q) Home
r) Function keys **F1** - **F6**

Keys

Key	Function
Function keys **F1**- **F6**	Correspond to six softkeys that appear on the bottom of the screen when the screen is activated.
Function keys **F7**- **F12**	User definable keys to execute chosen commands or access chosen screens.
Alphanumeric keys	To type letters and numbers.
Esc	Leaves the current screen without storing any changes.
Fn	Switches between the first and second level of function keys.
Enter	Selects the highlighted line and leads to the next logical menu / dialog. Starts the edit mode for editable fields. Opens a selectable list.
ON/OFF	If the instrument is already off: Turns on the instrument when held for 2 s. If the instrument is already on: Turns to Power Options menu when held for 2 s.
Favourites	Goes to a favourites menu.

Key	Function
Home	Switches to the SmartWorx Viva Main Menu. Switches to the Windows CE Start Menu when pressing Fn at the same time.
Arrow keys	Move the focus on the screen.
OK	Selects the highlighted line and leads to the next logical menu / dialog. Starts the edit mode for editable fields. Opens a selectable list.

3.2 Operating Principles

Keyboard and touch screen

The user interface is operated either by the keyboard or by the touch screen with supplied stylus. The workflow is the same for keyboard and touch screen entry, the only difference lies in the way information is selected and entered.

Operation by keyboard

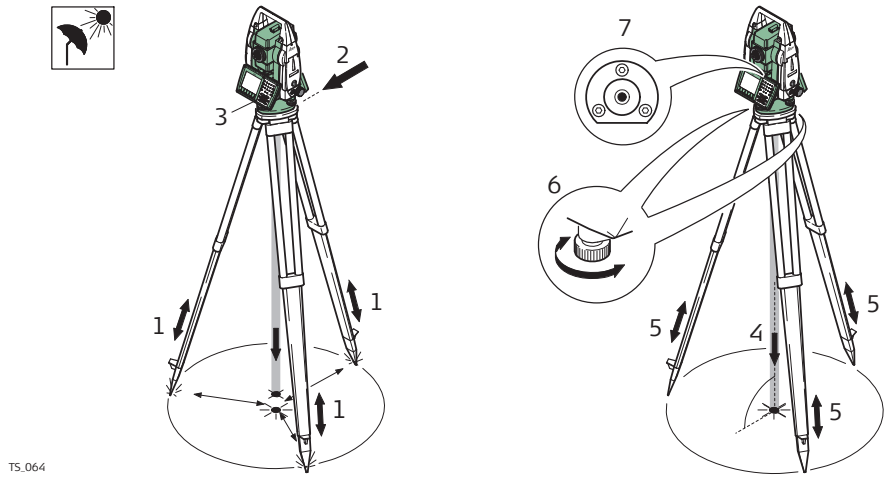
Information is selected and entered using the keys. Refer to "3.1 Keyboard" for a detailed description of the keys on the keyboard and their function.

Operation by touch screen

Information is selected and entered on the screen using the supplied stylus.

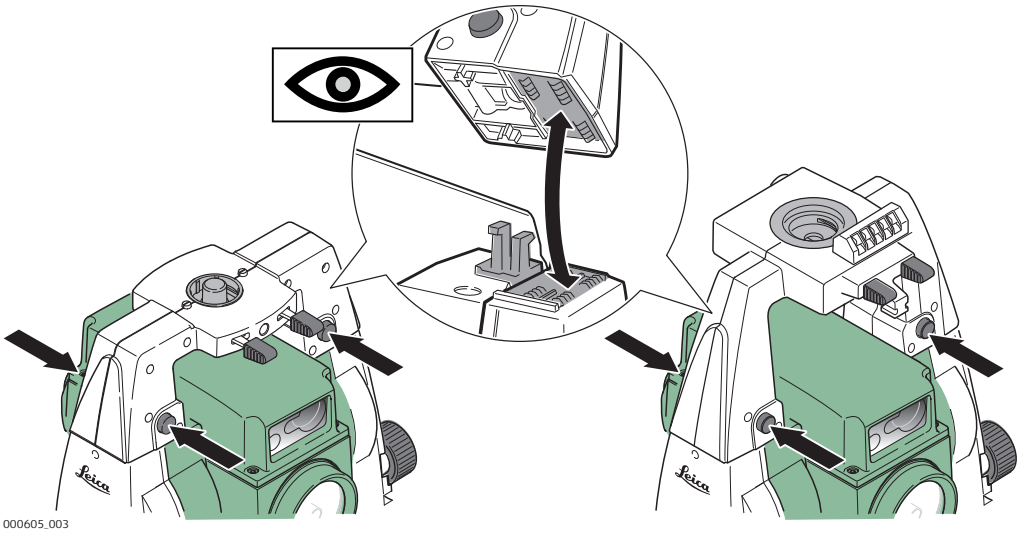
Operation	Description
To select an item	Tap on the item.
To start the edit mode in editable fields	Tap on the editable field.
To highlight an item or parts of it for editing	Drag the supplied stylus from the left to the right.
To accept data entered into an editable field and exit the edit mode	Tap on the screen outside of the editable field.
To open a context-sensitive menu	Tap on the item and hold for 2 s.

Instrument setup step-by-step

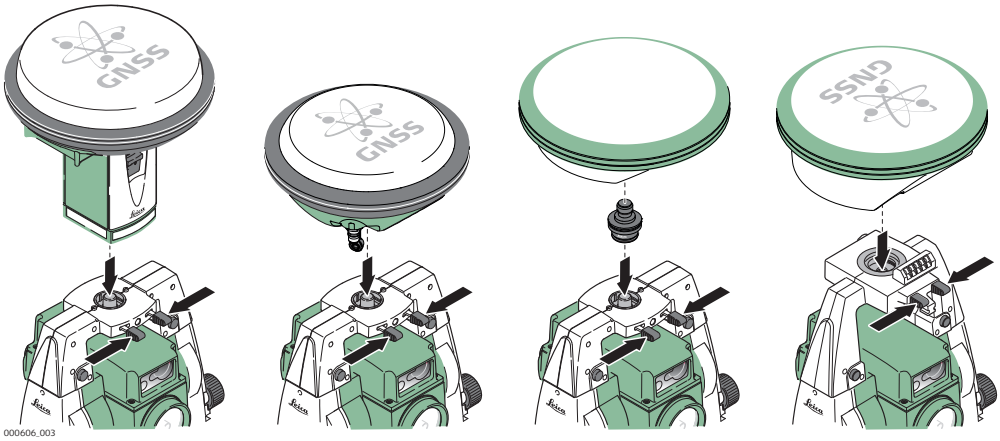


Step	Description
☞	Shield the instrument from direct sunlight and avoid uneven temperatures around the instrument.
1.	Extend the tripod legs to allow for a comfortable working posture. Position the tripod over the marked ground point, centring it as well as possible.
2.	Fasten the tribrach and instrument onto the tripod.
3.	Turn on the instrument by pressing . Select **Main Menu**/**Instrument**/**TPS settings**/**Level bubble & compensator** to activate the laser plummet and electronic level. For TS12 Robotic: Turn on the instrument by pressing ON for 2 s. Press **USER, STAT (F3)** to access the **Status Menu**. Select **Level & Laser Plummet** to access **STATUS Level & Laser Plummet**, activating the laser plummet.
4.	Move the tripod legs (1) and use the tribrach footscrews (6) to centre the plummet (4) over the ground point.
5.	Adjust the tripod legs to level the circular level (7).
6.	By using the electronic level, turn the tribrach footscrews (6) to level the instrument precisely.
7.	Centre the instrument precisely over the ground point (4) by shifting the tribrach on the tripod plate (2).
8.	Repeat steps 6. and 7. until the required accuracy is achieved.

SmartStation setup step-by-step

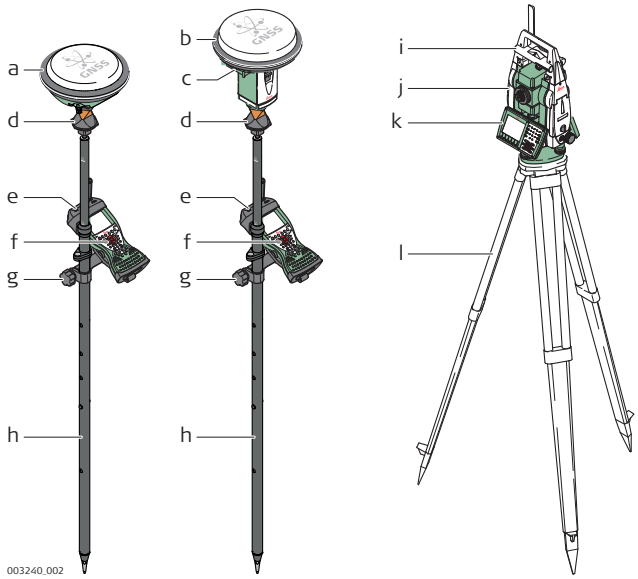


Step	Description
1.	Place the GAD110 adapter for the GS15/GS14/GS08plus antenna onto the instrument by simultaneously pressing and holding-in the four push buttons. For GS08plus: In addition to the GAD110 adapter, the GAD113 adapter is required. Place the GAD104 adapter for the GS12 antenna onto the instrument by simultaneously pressing and holding-in the four push buttons.
☞	Ensure that the interface connection on the underside of the adapter is on the same side as the Communication side cover.



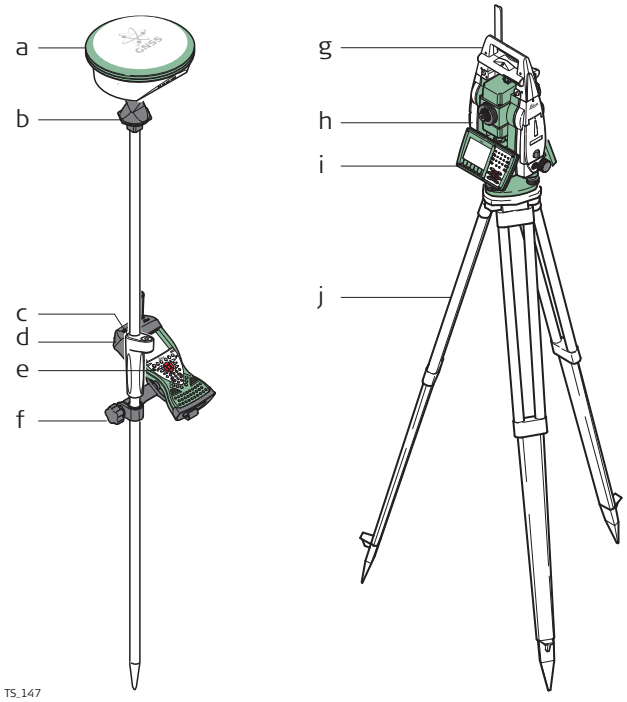
Step	Description
2.	Place the GS15/GS14/GS12/GS08plus antenna onto the adapter by simultaneously pressing and holding-in the two press clips.

SmartPole setup using GS15/GS14



a) GS14 instrument
b) GS15 instrument
c) RTK slot-in device
d) GRZ122 360° prism
e) CTR16 radio cap
f) CS15 field controller
g) GHT62 holder and GHT63 clamp
h) GLS31 pole with snap-lock positions
i) RH16 RadioHandle
j) Communication side cover, integrated
k) Instrument
l) Tripod

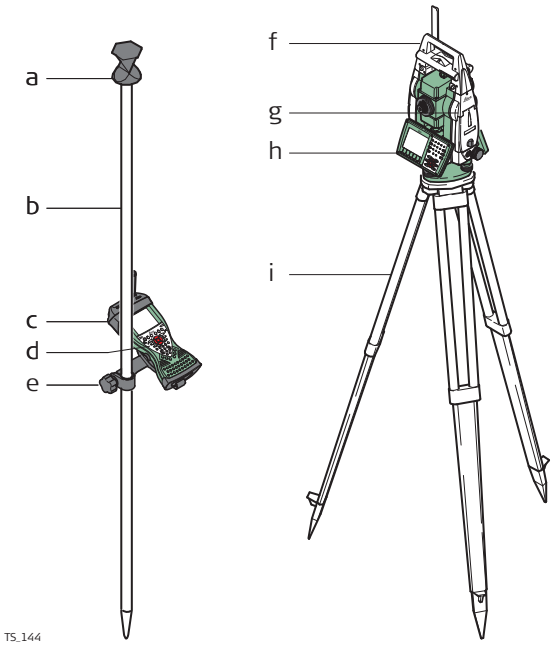
SmartPole setup using GS12



a) GS12 instrument
b) GRZ122 360° prism
c) CTR16 radio cap
d) GLS12 cm/GLS12F ft pole with snap-lock positions
e) CS15 field controller
f) GHT62 holder and GHT63 clamp
g) RH16 RadioHandle
h) Communication side cover, integrated
i) Instrument
j) Tripod

4.4 Setting up for Remote Control (with the RadioHandle)

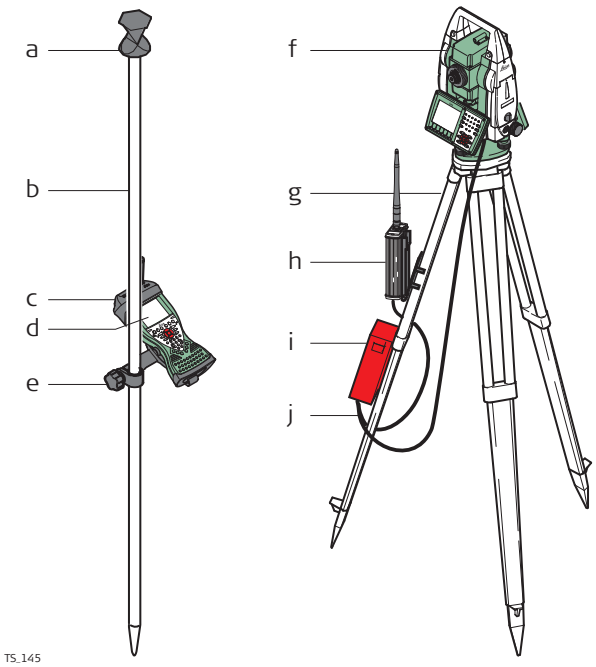
Setup for remote control with RadioHandle



a) 360° prism
b) Prism pole
c) CTR16 radio cap
d) CS15 field controller
e) GHT62 holder and GHT63 clamp
f) RH16 RadioHandle
g) Communication side cover
h) Instrument
i) Tripod

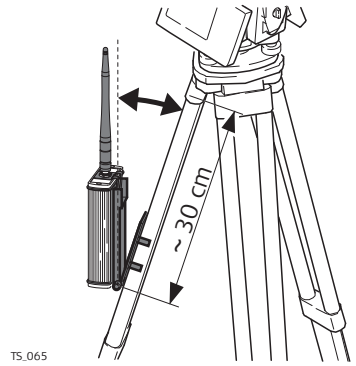
4.5 Setting up for Remote Control (with the TCPS29)

Setup for remote control with TCPS29



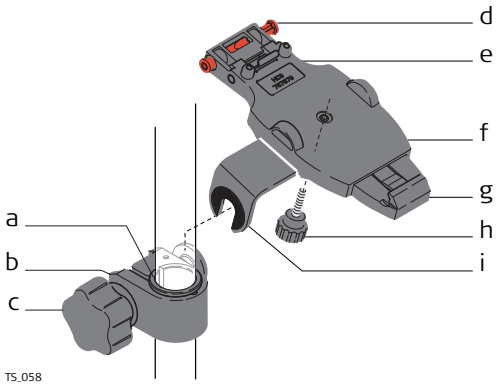
a) 360° prism
b) Prism pole
c) CTR16 radio cap
d) CS15 field controller
e) GHT62 holder and GHT63 clamp
f) Instrument
g) Tripod
h) TCPS29
i) External battery
j) Y-cable

Mount base radio to tripod step-by-step

Step	Description
1.	The GHT43 tripod adapter is used to mount the TCPS29 to all Leica standard tripods, and to optimise the radio transmission performance. Attach the TCPS29 to the adapter and then attach the adapter to the tripod leg.
2.	Adjust the angle of TCPS29 until it is vertical.
3.	Adjust the location of the adapter on the tripod leg so that there are no metallic objects in the horizontal plane around the antenna. ☞ Metallic objects near the antenna disturb radio transmissions.
4.	☞ To achieve the best performance from the TCPS29, mount it in a vertical position on the tripod leg, approximately 30 cm from the top. ☞ If the adapter is no longer able to retain its angle position, the adjustment bolt at the hinge can be tightened slightly.  TS_065

Components of the GHT62 holder

The GHT62 holder consists of some components, as shown in the diagram.



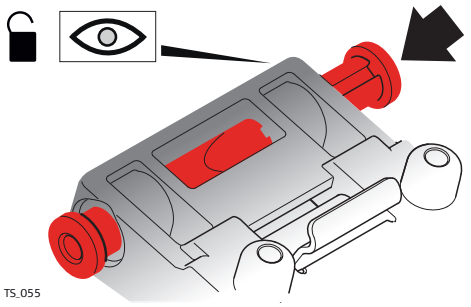
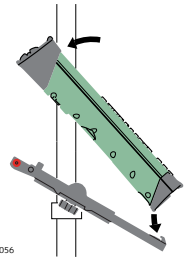
GHT63 clamp

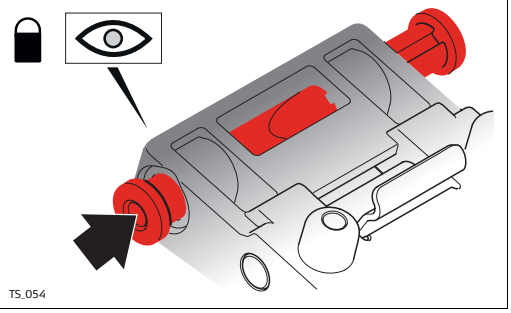
a) Plastic sleeve
b) Pole clamp
c) Clamp bolt

GHT62 holder

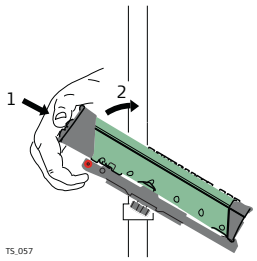
d) Locking pin
e) Top clip
f) Mounting plate (extendable)
g) Bottom clip
h) Tightening screw
i) Mounting arm

Fixing the CS field controller and GHT62 to a pole step-by-step

Step	Description
☞	If you use the CS15 field controller, extend the mounting plate of the holder first.
☞	For an aluminium pole, fit the plastic sleeve to the pole clamp.
1.	Insert the pole into the clamp hole.
2.	Attach the holder to the clamp using the clamp bolt.
3.	Adjust the angle and the height of the holder on the pole to a comfortable position.
4.	Tighten the clamp with the clamp bolt.
5.	Before the CS field controller is placed onto the mounting plate, ensure that the locking pin is put into the unlocked position. To unlock the locking pin, push the locking pin to the left.  TS_055
6.	Hold the CS field controller above the holder and lower the end of the CS field controller into the mounting plate.
7.	Apply slight pressure in a downward direction and then lower the top part of the CS field controller until the unit is clicked into the holder. The guides of the mounting plate aid in this action.  TS_056

Step	Description
8.	After the CS field controller is placed onto the mounting plate, ensure that the locking pin is put into the locked position. To lock the locking pin, push the locking pin to the right.  TS_054

Detaching the CS from a pole step-by-step

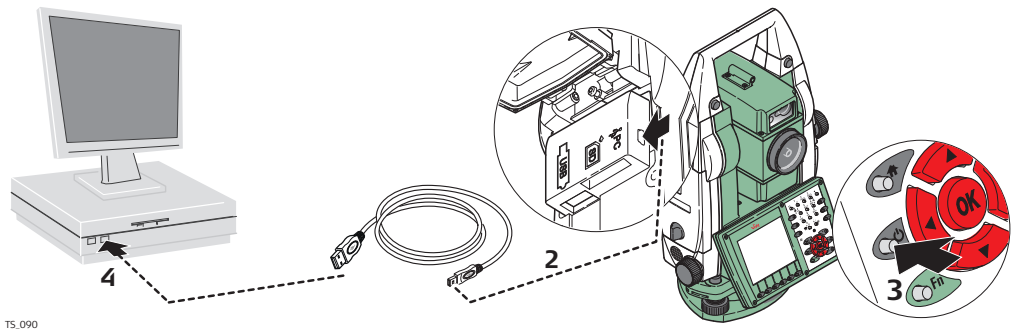
Step	Description
1.	Unlock the locking pin by pushing the locking pin to the left of the mounting plate.
2.	Place palm over the top of the CS until fingers grip the bar of the holder underneath.
3.	Push from the top of the CS toward the bar of the holder.
4.	While in this position, lift the top of the CS from the holder.  TS_057

Microsoft ActiveSync (for PCs with Windows XP operating system) or Windows Mobile Device Center (for PCs with Windows Vista or Windows 7/Windows 8 operating system) is the synchronisation software for Windows mobile-based pocket PCs. Microsoft ActiveSync or Windows Mobile Device Center enables a PC and a Windows mobile-based pocket PC to communicate.

Install Leica Viva USB drivers

Step	Description
1.	Start the PC.
2.	Insert the Leica Viva Series USB card.
3.	Run the **SetupViva&GR_USB_XX.exe** to install the drivers necessary for Leica Viva devices. Depending on the version (32bit or 64bit) of the operating system on your PC, you have to select between the three setup files following: • SetupViva&GR_USB_32bit.exe • SetupViva&GR_USB_64bit.exe • SetupViva&GR_USB_64bit_itanium.exe The setup has to be run only once for all Leica Viva devices.
4.	The **Welcome to InstallShield Wizard for Leica Viva & GR USB drivers** window appears. Ensure that all Leica Viva devices are disconnected from your PC before you continue!
5.	**Next>**.
6.	The **Ready to Install the Program** window appears.
7.	**Install**. The drivers will be installed on your PC. For PCs with Windows Vista or Windows 7/Windows 8 operating system: If not already installed, Windows Mobile Device Center will be installed additionally.
8.	The **InstallShield Wizard Completed** window appears.
9.	Check **I have read the instructions** and click **Finish** to exit the wizard.

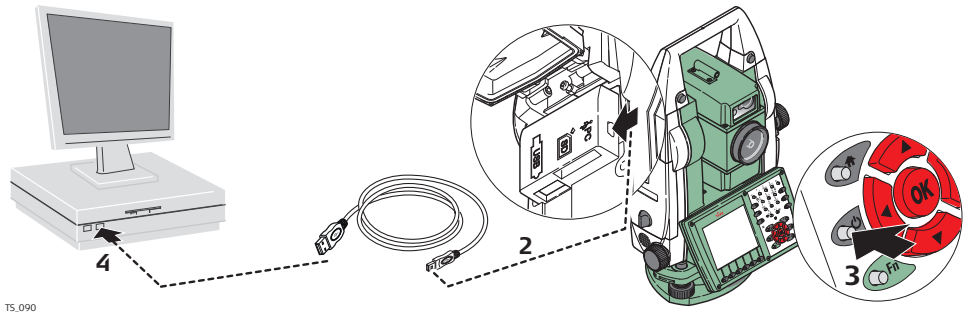
Connect USB cable to computer for the first time step-by-step



Step	Description
1.	Start the computer.
2.	Plug the GEV223 cable into TPS instrument.
3.	Turn on the TPS instrument.
4.	Plug the GEV223 cable into the USB port of the computer. The **Found New Hardware Wizard** starts up automatically.
5.	Check **Yes, this time only**. **Next>**.

Step	Description
6.	Check **Install the software automatically (Recommended)**. **Next>**. The software for **Remote NDIS based LGS TS Device** will be installed on your computer
7.	**Finish**.
8.	The **Found New Hardware Wizard** starts up automatically a second time.
9.	Check **Yes, this time only**. **Next>**.
10.	Check **Install the software automatically (Recommended)**. **Next>**. The software for **LGS TS USB Device** will be installed on your computer.
11.	**Finish**.
	For PCs with Windows XP operating system:
12.	Run the ActiveSync installation program if not already installed.
13.	Allow USB connections inside the **Connection Settings** window of ActiveSync.
	For PCs with Windows Vista or Windows 7/Windows 8 operating system:
14.	Windows Mobile Device Center starts up automatically. If does not start automatically, start Windows Mobile Device Center.

Connect to computer via USB cable step-by-step



Step	Description
1.	Start the PC.
2.	Plug the GEV223 cable into TS instrument.
3.	Turn on the TS instrument.
4.	Plug the GEV223 cable into the USB port of the computer.
	For PCs with Windows XP operating system:
	☞ ActiveSync starts up automatically. If does not start automatically, start ActiveSync. If not already installed, run the ActiveSync installation program.
5.	Allow USB connections inside the **Connection Settings** window of ActiveSync.
6.	Click **Explore** in ActiveSync.
	☞ The folders on the TS instrument are displayed under **Mobile Devices**. The folders of the data storage device can be found in either of the following folders: • Leica Geosystems\SmartWorx Viva • **SD Card** • **USB memory device**
	For PCs with Windows Vista or Windows 7/Windows 8 operating system:
	☞ Windows Mobile Device Center starts up automatically. If does not start automatically, start Windows Mobile Device Center.

4.8 Power Functions

Turning TS instrument on

Press and hold power key ( ) for 2 s.

☞ TS Instrument must have a power supply.

Turning TS instrument off

Press and hold power key ( ) for 5 s.

☞ TS instrument must be on.

Power Options menu

Press and hold power key ( ) for 2 s to open **Power Options** menu.

☞ Instrument must be on.

Option	Description
Turn off	Turn TS instrument off.
Stand-by	Put TS instrument into stand-by mode. ☞ In stand-by mode, the TS instrument shuts down and reduces power consumption. Rebooting from stand-by mode is quicker than a cold start after turning off.
Lock keyboard	Locks the keyboard. Option turns to **Unlock keyboard**.
Turn off touch screen	Disables touch screen. Option turns to **Turn on touch screen**.
Reset...	Performs one of the following options: • **Restart** (restarts Windows CE) • **Reset Windows CE** (resets Windows CE and communication settings to factory defaults) • **Reset installed software** (resets settings of all installed software) • **Reset Windows CE and installed software** (resets Windows CE and settings of all installed software)

4.9 Batteries

4.9.1 Operating Principles

First-time use / Charging batteries

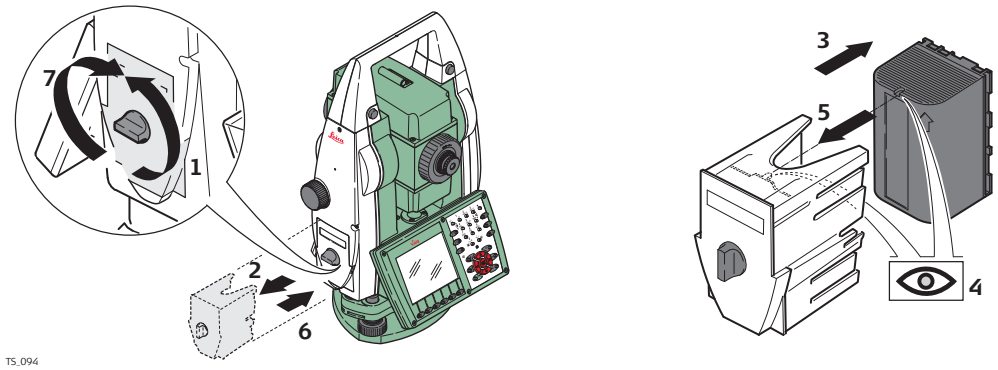
- The battery must be charged prior to using it for the first time.
- The permissible temperature range for charging is between 0°C to +40°C/ +32°F to +104°F. For optimal charging, we recommend charging the batteries at a low ambient temperature of +10°C to +20°C/+50°F to +68°F if possible.
- It is normal for the battery to become warm during charging. Using the chargers recommended by Leica Geosystems, it is not possible to charge the battery if the temperature is too high.
- For Li-Ion batteries, a single refreshing cycle is sufficient. We recommend carrying out a refreshing cycle when the battery capacity indicated on the charger or on a Leica Geosystems product deviates significantly from the actual battery capacity available.

Operation / Discharging

- The batteries can be operated from -20°C to +55°C/-4°F to +131°F.
- Low operating temperatures reduce the capacity that can be drawn; high operating temperatures reduce the service life of the battery.

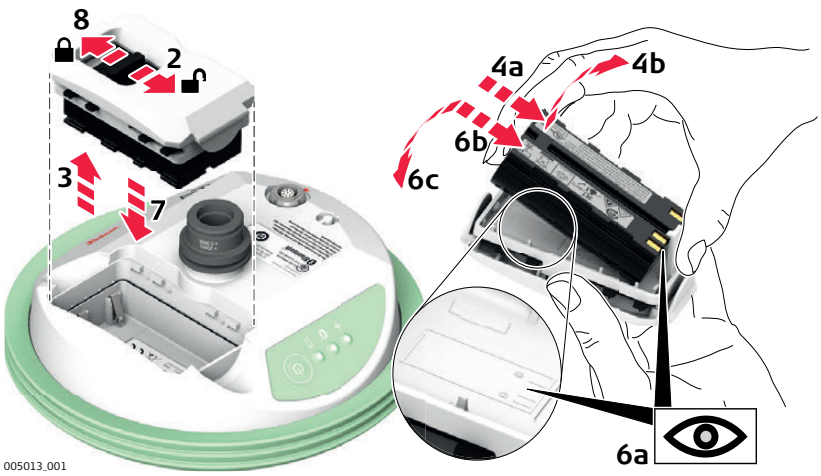
4.9.2 Battery for the TS Instrument

Change battery step-by-step



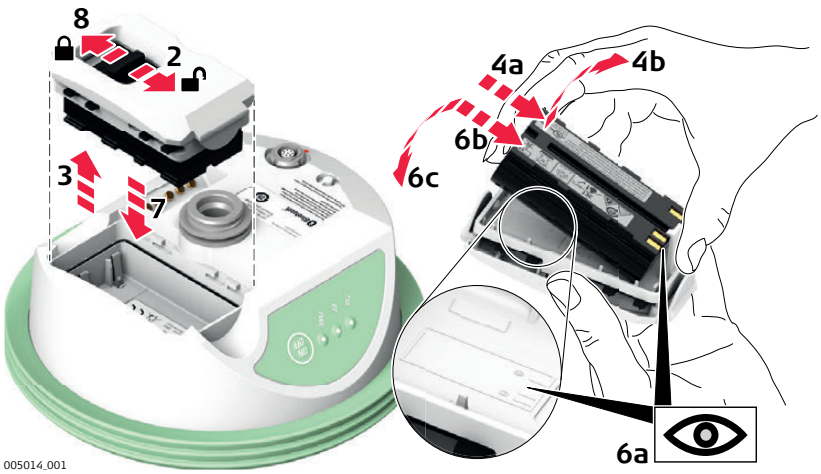
Step	Description
1.	Face the instrument so that the vertical drive screw is on the left. The battery compartment is below the vertical drive. Turn the knob to the vertical position, opening the lid of the battery compartment.
2.	Pull out the battery housing.
3.	Pull the battery from the battery housing.
4.	A pictogram of the battery is displayed inside the battery housing. This pictogram is a visual aid to assist in placing the battery correctly.
5.	Place the battery into the battery housing, ensuring that the contacts are facing outward. Click the battery into position.
6.	Place the battery housing into the battery compartment. Push the battery housing in until it fits completely into the battery compartment.
7.	Turn the knob to lock the battery compartment. Ensure that the knob is returned to its original horizontal position.

Change battery step-by-step (GS08plus)



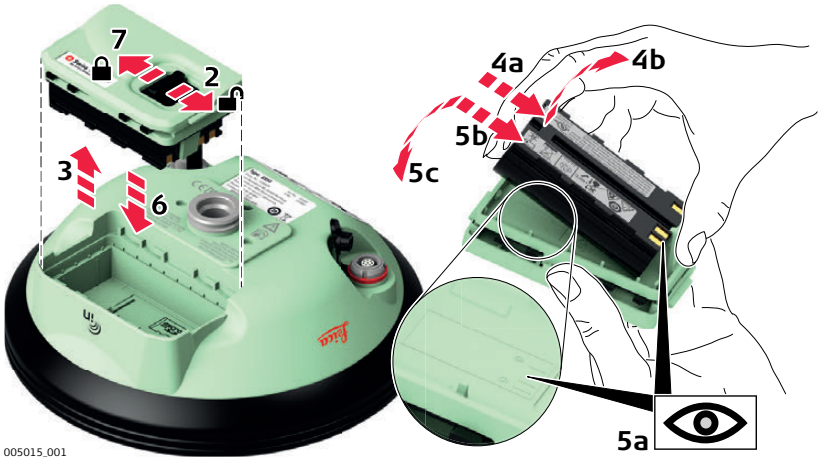
Step	Description
1.	Turn GS08plus over to gain access to the battery compartment.
2.	Open the battery compartment by pushing the slide fastener in the direction of the arrow with the open-lock symbol.
3.	Pull out the battery housing. The battery is attached to the housing.
4.	Hold the battery housing and pull the battery from the battery housing.
5.	A polarity of the battery is displayed inside the battery housing. This is a visual aid to assist in placing the battery correctly.
6.	Place the battery onto the battery housing, ensuring that the contacts are facing outward. Click the battery into position.
7.	Place the battery housing into the battery compartment.
8.	Close the battery compartment by pushing the slide fastener in the direction of the arrow with the close-lock symbol.

Change battery step-by-step (GS12)



Step	Description
1.	Turn GS12 over to gain access to the battery compartment.
2.	Open the battery compartment by pushing the slide fastener in the direction of the arrow with the open-lock symbol.
3.	Pull out the battery housing. The battery is attached to the housing.
4.	Hold the battery housing and pull the battery from the battery housing.
5.	A polarity of the battery is displayed inside the battery housing. This is a visual aid to assist in placing the battery correctly.
6.	Place the battery onto the battery housing, ensuring that the contacts are facing outward. Click the battery into position.
7.	Place the battery housing into the battery compartment.
8.	Close the battery compartment by pushing the slide fastener in the direction of the arrow with the close-lock symbol.

Change battery step-by-step (GS14)



Step	Description
1.	The battery is inserted in the bottom part of the instrument.
2.	Push the slide fastener of the battery compartment in the direction of the arrow with the open-lock symbol.
3.	Remove the cover from the battery compartment.
4.	Push the battery slightly upwards and at the same time pull out the bottom part of the battery. This releases the battery from its fixed position.
5.	With the battery contacts facing upwards, slide the battery into the cover of the battery compartment. Push the battery upwards so that it locks into position.
6.	Insert the cover of the battery compartment into the compartment.
7.	Push the slide fastener in the direction of the arrow with the close-lock symbol.

Change battery step-by-step (GS15)

Step	Description
☞	The batteries are inserted in the bottom part of the instrument.
1.	Push the slide fastener of one of the battery compartments in the direction of the arrow with the open-lock symbol.
2.	Remove the cover from the battery compartment.
3.	With the battery contacts facing upwards, slide the battery into the cover of the battery compartment.
4.	Push the battery upwards so that it locks into position.
5.	Insert the cover of the battery compartment into the compartment.
6.	Push the slide fastener in the direction of the arrow with the close-lock symbol.

4.10 Operating the Laser Guide

Description

The Laser Guide can be operated and configured manually or via the serial RS232 interface of the TS15 G instrument.

☞ The Laser Guide is automatically turned off temporarily during distance measurement.

☞ For instruments equipped with reflectorless EDM the Laser Guide is automatically turned off when the reflectorless laser pointer is turned on.

☞ Refer to the GeoCOM Reference Manual for further information on GeoCOM.

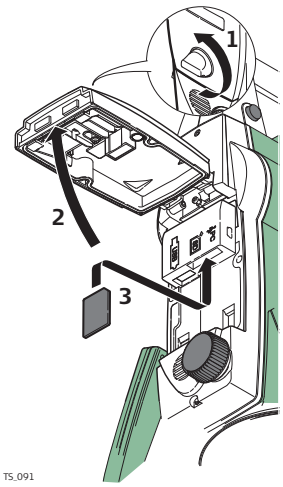
4.11 Working with the Memory Device

☞
- Keep the card dry.
- Use it only within the specified temperature range.
- Do not bend the card.
- Protect the card from direct impacts.

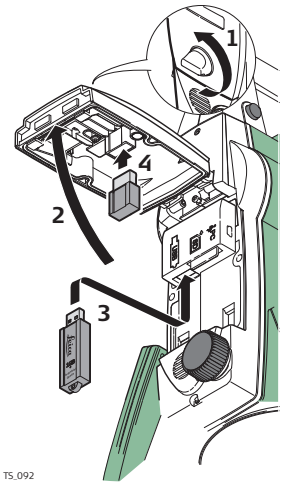
☞ Failure to follow these instructions could result in data loss and/or permanent damage to the card.

Insert and remove an SD card step-by-step

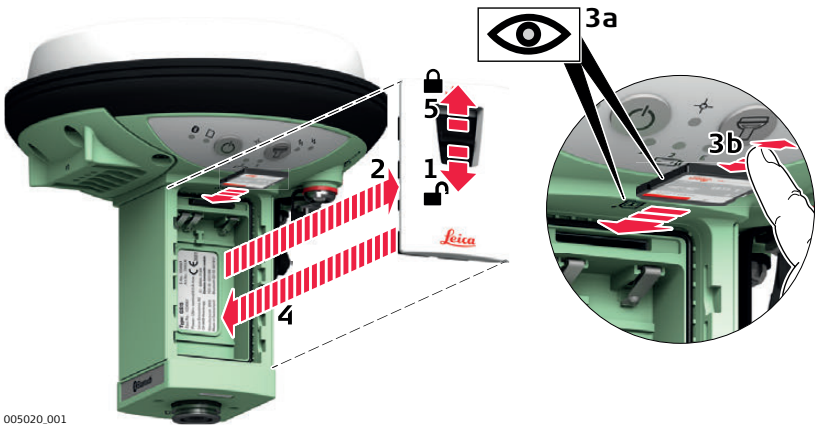
Step	Description
☞	The SD card is inserted into a slot inside the Communication side cover of the instrument.
1.	Turn the knob on the Communication side cover to the vertical position to unlock the communication compartment.
2.	Open the lid of the communication compartment to access the communication ports.
3.	Slide the SD card firmly into the SD slot until it clicks into position. ☞ The card must be held with the contacts at the top and facing toward the instrument. ☞ Do not force the card into the slot.
4.	Close the lid and turn the knob to the horizontal position to lock the communication compartment.
5.	To remove the SD card, open the lid of the communication compartment and gently press on the top of the card to release it from the slot.



Insert and remove a USB stick step-by-step

Step	Description	
☞	The USB stick is inserted into the USB host port inside the Communication side cover of the instrument.	
1.	Turn the knob on the Communication side cover to the vertical position to unlock the communication compartment.	
2.	Open the lid of the communication compartment to access the communication ports.	
3.	Slide the USB stick with the Leica logo facing you firmly into the USB host port until it clicks into position. ☞ Do not force the USB stick into the port.	
4.	If desired, store the lid of the USB stick on the underside of the compartment lid.	
5.	Close the lid and turn the knob to the horizontal position to lock the compartment.	
6.	To remove the USB stick, open the lid of the compartment and slide the USB stick out of the port.	

Insert and remove an SD card into GS15 step-by-step



Step	Description
☞	The SD card is inserted into a slot inside the battery compartment 1 of the instrument.
1.	Push the slide fastener of battery compartment 1 in the direction of the arrow with the open-lock symbol.
2.	Remove the cover from battery compartment 1.
3.	Slide the card firmly into the slot until it clicks into position.
☞	Do not force the card into the slot. The card should be held with the contacts upwards and facing the slot.
☞	To remove the card, push the slide fastener of battery compartment 1 in the direction of the arrow with the open-lock symbol and remove the cover. Gently press on the top of the card to release it from the slot. Remove the SD card.
4.	Insert the cover into battery compartment 1.
5.	Push the slide fastener in the direction of the arrow with the close-lock symbol.

Devices fitting into the GS15 GNSS instrument

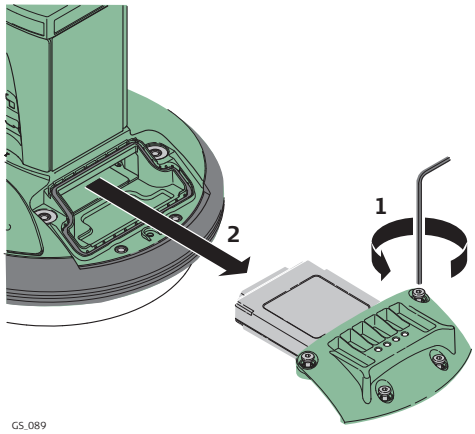
Digital cellular phones fitting into the GS15 GNSS instrument

Digital cellular phone	Device
Telit UC864-G	SLG1
CINTERION MC75i	SLG2
CDMA Telit CC864-DUAL (US)	SLC1, SLC2

Radios fitting into the GS15 GNSS instrument

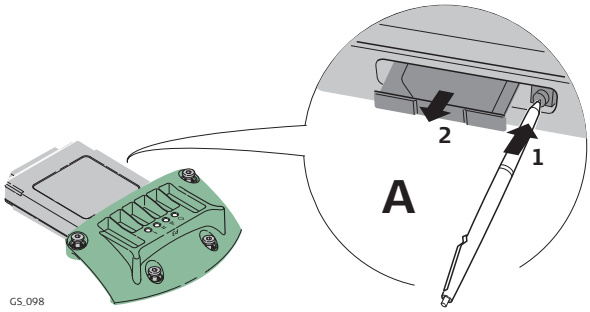
Radio	Device
Pacific Crest PDL, transceive	SLR3-1
Pacific Crest PDL, transceive	SLR3-2
Satelline 3AS, transmit	SLR1
Satelline 3AS, receive	SLR2
Satelline M3-TR1, transceive	SLR5

Insert and remove a slot-in-device step-by-step



Step	Description
☞	Turn over the GS15 to gain access to the slot-in-device compartment.
1.	Loosen the screws of the compartment cover with the supplied Allen key.
2.	Remove the compartment cover.
3.	Attach the slot-in-device to the compartment cover.
4.	Insert the compartment cover into the compartment (port P3).
5.	Tighten the screws. ☞ All screws have to be tightened to ensure that the instrument is waterproof.
☞	For the equipment setup as real-time base station with radio, it's recommended to use an external radio antenna mounted on a second tripod. This increases the height of the radio antenna and therefore maximises radio coverage. Refer to the Leica Viva GNSS Getting Started Guide for detailed information about the setup.

Insert and remove a SIM card step-by-step



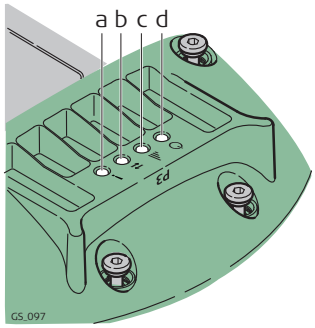
Step	Description
☞	The SIM card is inserted into a slot on the side of the SLG1/SLG2.
☞	Take the SIM card and a pen.
1.	Using the pen, press the small button of the SIM card slot to eject the SIM card holder.
2.	Take the SIM card holder out off the SLG1/SLG2.
3.	Place the SIM card into the SIM card holder, the chip facing up.
4.	Insert the SIM card holder into the SIM card slot, the chip facing the connectors inside the slot.

LED indicators

Description

Each slot-in-device for a radio or digital cellular phones has **L**ight **E**mitting **D**iode indicators on the bottom side. They indicate the basic device status.

Diagram



a) Mode LED, available for Satelline 3AS
b) Data transfer LED
c) Signal strength LED
d) Power LED

Description of the LEDs

IF the	on	is	THEN
Mode LED	SLR1, SLR2 with Satelline 3AS, SLR5 with Satelline M3-TR1	red	the device is in the programming mode controlled from the PC via cable.
Data transfer LED	any device	off	data is not being transferred.
		flashing green	data is being transferred.
Signal strength LED	SLC1 (US), SLC2 (US) with CDMA Telit CC864-DUAL	red	device is on, not registered on the network.
		flashing red	device is on, registered on the network.
		off	download mode or device is off.

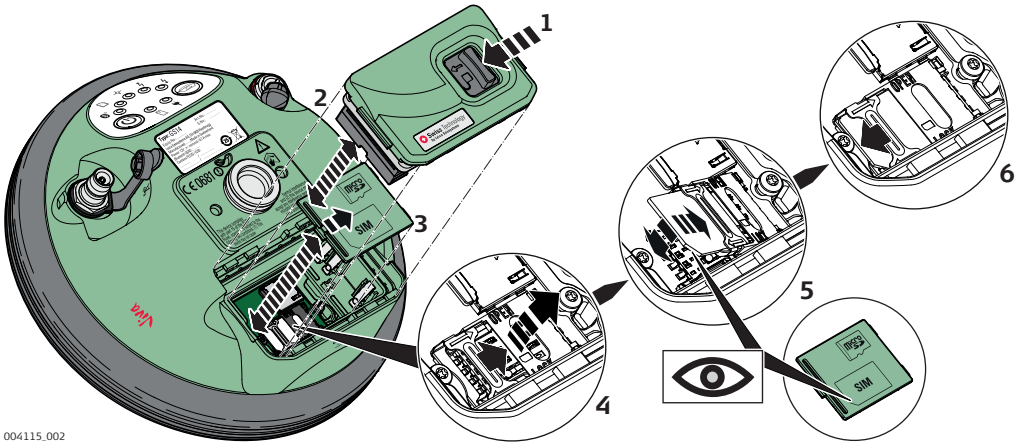
IF the	on	is	THEN
	SLG1 with Telit UC864-G, SLG2 with CINTERION MC75i	red	call is in progress.
		red: long flash, long break	no SIM card inserted, no PIN entered or network search, user authentication or network login in progress.
		red: short flash, long break	logged on to network, no call in progress.
		red: flashing red, long break	GPRS PDP context activated.
		red: long flash, short break	Packet switched data transfer is in progress.
		off	device is off.
	SLR3-1, SLR3-2 with Pacific Crest ADL	red	the communication link, **D**ata **C**arrier **D**etection, is okay on the roving instrument.
		flashing red	the communication link, **D**ata **C**arrier **D**etection, is okay on the roving instrument, but signal is weak.
		off	the DCD is not okay.
	SLR1, SLR2 with Satelline 3AS, SLR5 with Satel-line M3-TR1	red	the communication link, **D**ata **C**arrier **D**etection, is okay on the roving instrument.
		flashing red	the communication link, **D**ata **C**arrier **D**etection, is okay on the roving instrument, but signal is weak.
		off	the DCD is not okay.
Power LED	any device	off	power is off.
		green	power is okay.

Devices fitted into the GS14 GNSS instrument

Depending on the GS14 model one or two of the following devices are integrated:

Type	Device
2G GSM	Cinterion BGS2-W
3.75G GSM/UMTS	Cinterion PHS8-P
3.75G GSM/UMTS	Cinterion PXS8
RX UHF radio	Satel OEM20, receive
RX/TX UHF radio	Satel OEM22, receive/transmit

Insert and remove a SIM card step-by-step



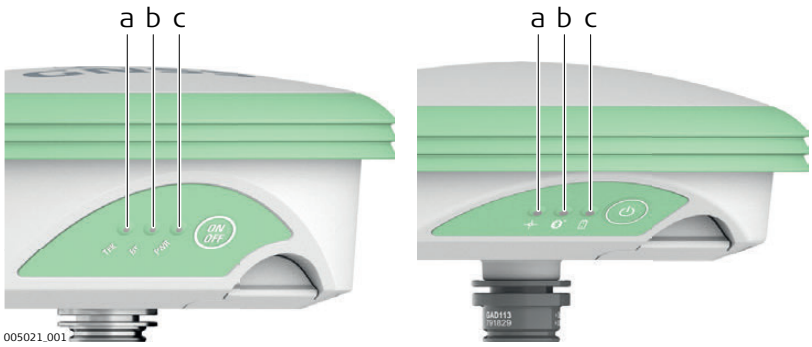
Step	Description
☞	Inserting/removing the SIM card while the GS14 is turned on can result in permanent damage to the card. Only insert/remove the SIM card when the GS14 is switched off.
☞	The SIM card is inserted into a slot inside the battery compartment.
1.	Push the slide fastener of the battery compartment in the direction of the arrow with the open-lock symbol.
2.	Remove the cover from battery compartment.
3.	Press the latch of the SIM/microSD card cover and remove the cover.
4.	Push the SIM card holder in the direction of the OPEN arrow and flip it up.
5.	Place the SIM card into the SIM card holder, the chip facing the connectors inside the slot - as shown on the SIM/microSD card cover. Press the SIM card holder down.
6.	Push the SIM card holder in the direction of the LOCK arrow to close.

LED indicators

Description

The GS08plus/GS12 instrument has **L**ight **E**mitting **D**iode indicators. They indicate the basic instrument status.

Diagram



a) Tracking LED (TRK)
b) Bluetooth LED (BT)
c) Power LED (PWR)

Description of the LEDs

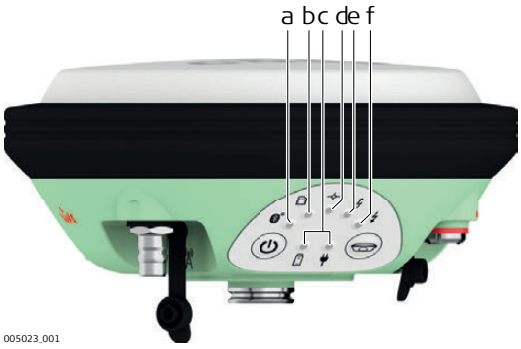
IF the	is	THEN
TRK LED	off	No satellites are tracked.
	flashing green	Less than four satellites are tracked, a position is not yet available.
	green	Enough satellites are tracked to compute a position.
	red	GS08plus/GS12 instrument is initialising.
BT LED	green	Bluetooth is in data mode and ready for connecting.
	purple	Bluetooth is connecting.
	blue	Bluetooth has connected.
	flashing blue	Data is being transferred.
GS12 PWR LED	off	Power is off.
	green	Power is okay.
	flashing green	Power is low. The remaining time for which enough power is available depends on the type of survey, the temperature and the age of the battery.
GS08plus PWR LED	off	Power is off.
	green	Power is 100% - 20%.
	red	Power is 20% - 5%.
	flashing red	Power is low (< 5%). The remaining time for which enough power is available depends on the type of survey, the temperature and the age of the battery.

LED indicators

Description

The GS14 GNSS instrument has **L**ight **E**mitting **D**iode indicators. They indicate the basic instrument status.

Diagram



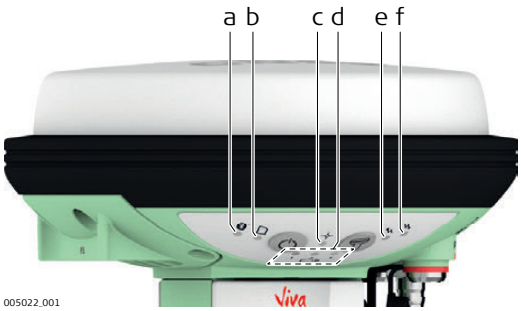
a) Bluetooth LED
b) Storage LED
c) Power LEDs
d) Position LED
e) RTK Base LED
f) RTK Rover LED

LED indicators on GS15

Description

The GS15 has **L**ight **E**mitting **D**iode indicators. They indicate the basic instrument status.

Diagram



a) Bluetooth LED
b) Storage LED
c) Position LED
d) Power LEDs
e) RTK Base LED
f) RTK Rover LED

Description of the LEDs

IF the	is	THEN
Bluetooth LED	green	Bluetooth is in data mode and ready for connecting.
	purple	Bluetooth is connecting.
	blue	Bluetooth has connected.
Storage LED	off	no SD card is inserted or GS15 is switched off.
	green	SD card is inserted but no raw data is being logged.
	flashing green	raw data is being logged.
	flashing yellow	raw data is being logged but only 10% memory left.
	flashing red	raw data is being logged but only 5% memory left.
	red	SD card is full, no raw data is being logged.
	fast flashing red	no SD card is inserted but GS15 is configured to log raw data.

IF the	is	THEN
Position LED	off	no satellites are tracked or GS15 is switched off.
	flashing yellow	less than four satellites are tracked, a position is not yet available.
	yellow	a navigated position is available.
	flashing green	a code-only position is available.
	green	a fixed RTK position is available.
Power LED (active battery*1)	off	battery is not connected, flat or GS15 is switched off.
	green	power is 40% - 100%.
	yellow	power is 20% - 40%. The remaining time for which enough power is available depends on the type of survey, the temperature and the age of the battery.
	red	power is 5% - 20%.
	fast flashing red	power is low (< 5%).
Power LED (passive battery*2)	off	battery is not connected, flat or the GS15 is switched off.
	flashing green	power is 40% - 100%. LED is green for 1 s every 10 s.
	flashing yellow	power is 20% - 40%. LED is yellow for 1 s every 10 s.
	flashing red	power is less than 20%. LED is red for 1 s every 10 s.
RTK Rover LED	off	GS15 is in RTK base mode or GS15 is switched off.
	green	GS15 is in rover mode. No RTK data is being received at the interface of the communication device.
	flashing green	GS15 is in rover mode. RTK data is being received at the interface of the communication device.
RTK Base LED	off	GS15 is in RTK rover mode or GS15 is switched off.
	green	GS15 is in RTK base mode. No RTK data is being passed to the RX/TX interface of the communication device.
	flashing green	GS15 is in RTK base mode. Data is being passed to the RX/TX interface of the communication device.

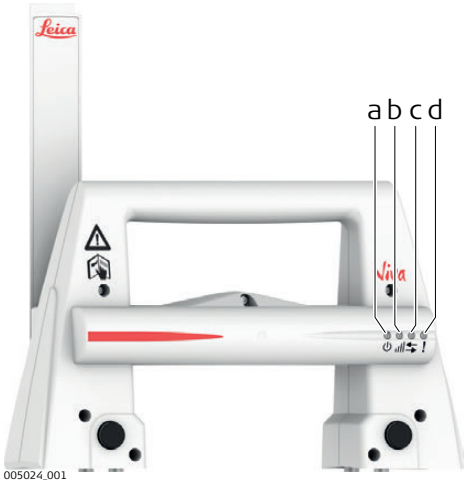
*1 The battery, which currently powers the GS15 GNSS instrument.
*2 Other batteries, which are inserted or connected but are not currently power the GS15 GNSS instrument.

LED Indicators on RadioHandle

Description

The RadioHandle has **L**ight **E**mitting **D**iode indicators. They indicate the basic RadioHandle status.

Diagram of the LED Indicators

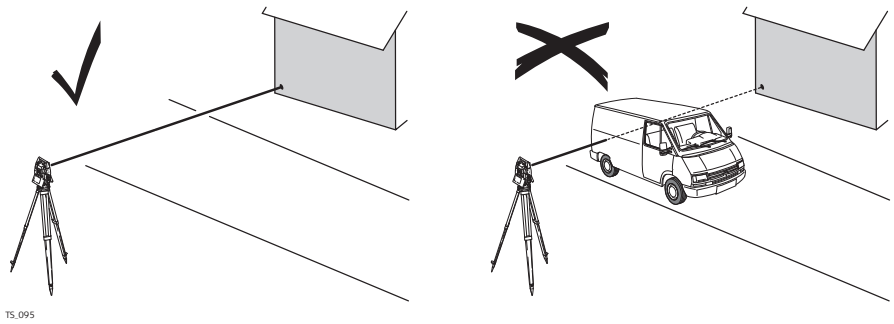


a) Power LED
b) Link LED
c) Data Transfer LED
d) Mode LED

Description of the LED Indicators

IF the	is	THEN
Power LED	off	power is off.
	green	power is on.
Link LED	off	no radio link to field controller.
	red	radio link to field controller.
Data Transfer LED	off	no data transfer to/from field controller.
	green or green flashing	data transfer to/from field controller.
Mode LED	off	data mode.
	red	configuration mode.

Distance measurement



When measurements are being made using the red laser EDM, the results can be influenced by objects passing between the EDM and the intended target surface. This occurs because reflectorless measurements are made to the first surface returning sufficient energy to allow the measurement to take place. For example, if the intended target surface is the surface of a building, but a vehicle passes between the EDM and the target surface as the measurement is triggered, the measurement may be made to the side of the vehicle. The result is the distance to the vehicle, not to the surface of the building.
If using the long range measurement mode (› 1000 m, › 3300 ft) to prisms, and an object passes within 30 m of the EDM as the measurement is triggered, the distance measurement may be similarly effected due to the strength of the laser signal.

☞ Very short distances can also be measured reflectorless in **Prism** mode to well reflecting natural targets. The distances are corrected with the additive constant defined for the active reflector.

⚠ **CAUTION** Due to laser safety regulations and measuring accuracy, using the Long Range Reflectorless EDM is only allowed to prisms that are more than 1000 m (3300 ft) away.

☞ Accurate measurements to prisms should be made in **Prism** mode.

☞ When a distance measurement is triggered, the EDM measures to the object which is in the beam path at that moment. If a temporary obstruction, for example a passing vehicle, heavy rain, fog or snow is between the instrument and the point to be measured, the EDM may measure to the obstruction.

☞ Do not measure with two instruments to the same target simultaneously to avoid getting mixed return signals.

ATR/lock

Instruments equipped with an ATR sensor permit automatic angle and distance measurements to prisms. The prism is sighted with the optical sight. After initiating a distance measurement, the instrument sights the prism centre automatically. Vertical and horizontal angles and the distance are measured to the centre of the prism. The lock mode enables the instrument to follow a moving prism.

☞ As with all other instrument errors, the collimation error of the automatic aiming must be redetermined periodically. Refer to "5 Check & Adjust" about checking and adjusting instruments.

☞ When a measurement is triggered while the prism is still moving, distance and angle measurements may not be made for the same position and coordinates may vary.

☞ If the prism location is changed too quickly, the target may be lost. Make sure that the speed does not exceed the figure given in the technical data.

5 Check & Adjust

5.1 Overview

Description

Leica Geosystems instruments are manufactured, assembled and adjusted to the best possible quality. Quick temperature changes, shock or stress can cause deviations and decrease the instrument accuracy. It is therefore recommended to check and adjust the instrument from time to time. This check and adjust can be done in the field by running through specific measurement procedures. The procedures are guided and must be followed carefully and precisely as described in the following chapters. Some other instrument errors and mechanical parts can be adjusted mechanically.

Electronic adjustment

The following instrument errors can be checked and adjusted electronically:

l, t	Compensator longitudinal and transversal index errors
i	Vertical index error, related to the standing axis
c	Horizontal collimation error, also called line of sight error
a	Tilting axis error
ATR	ATR zero point error for Hz and V - option

If the compensator and the horizontal corrections are activated in the instrument configuration, every angle measured in the daily work is corrected automatically . Select **Main Menu**: **Instrument\TPS settings\Level bubble & compensator** to check whether the tilt correction and the horizontal correction are turned on.
The results are displayed as errors but used with the opposite sign as corrections when applied to measurements.

View current adjustment errors

To view the adjustment errors currently used, select **Main Menu**: **User\Check & Adjust** to open the **Check & Adjust Wizard**. Select the option **View the current values**.

Mechanical adjustment

The following instrument parts can be adjusted mechanically:
- Circular level on instrument and tribrach
- Optical plummet - option on tribrach
- Allen screws on tripod

Precise measurements

To get precise measurements in the daily work, it is important:
- To check and adjust the instrument from time to time.
- To take high precision measurements during the check and adjust procedures.
- To measure targets in two faces. Some of the instrument errors are eliminated by averaging the angles from both faces.

☞

During the manufacturing process, the instrument errors are carefully determined and set to zero. As mentioned above, these errors can change and it is highly recommended to redetermine them in the following situations:
- Before the first use
- Before every high precision survey
- After rough or long transportation
- After long working periods
- After long storage periods
- If the temperature difference between current environment and the temperature at the last calibration is more than 20°C

Summary of errors to be adjusted electronically

Instrument error	Effects Hz	Effects V	Elimination with two face measurement	Automatically corrected with proper adjustment
c - Line of sight error	✓	-	✓	✓
a - Tilting axis error	✓	-	✓	✓
l - Compensator index error	-	✓	✓	✓
t - Compensator index error	✓	-	✓	✓
i - Vertical index error	-	✓	✓	✓
ATR Collimation error	✓	✓	-	✓

5.2 Preparation

Before determining the instrument errors, the instrument has to be levelled using the electronic level. Select **Main Menu**: **Instrument\TPS settings\Level bubble & compensator** to access the **Level Bubble & Compensator** screen.
The tribrach, the tripod and the underground should be stable and secure from vibrations or other disturbances.

The instrument should be protected from direct sunlight to avoid thermal warming.
It is also recommended to avoid strong heat shimmer and air turbulence. The best conditions are early in the morning or with overcast sky.

Before starting to work, the instrument has to become acclimatised to the ambient temperature. Approximately two minutes per °C of temperature difference from storage to working environment, but at least 15 min, should be taken into account.

Even after adjustment of the ATR, the crosshairs may not be positioned exactly on the centre of the prism after an ATR measurement has been completed. This outcome is a normal effect. To speed up the ATR measurement, the telescope is normally not positioned exactly on the centre of the prism. These small deviations/ATR offsets, are calculated individually for each measurement and corrected electronically. This means that the horizontal and vertical angles are corrected twice: first by the determined ATR errors for Hz and V, and then by the individual small deviations of the current aiming.

Next step

IF the task is to	THEN
adjust a combination of instrument errors	Refer to "5.3 Combined Adjustment (l, t, i, c and ATR)".
adjust the tilting axis	Refer to "5.4 Tilting Axis Adjustment (a)".
adjust the circular level	Refer to "5.5 Adjusting the Circular Level of the Instrument and Tribrach".
adjust the laser/optical plummet	Refer to "5.7 Inspecting the Laser Plummet of the Instrument".
adjust the tripod	Refer to "5.9 Servicing the Tripod".

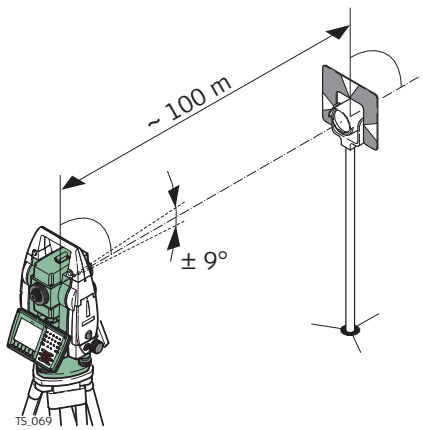
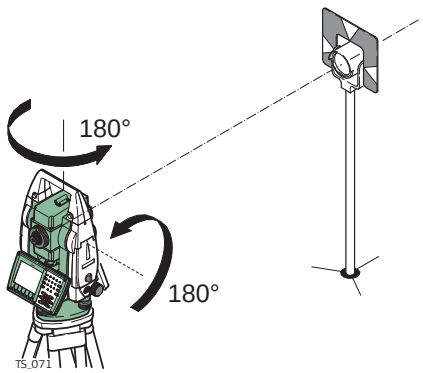
Description

The combined adjustment procedure determines the following instrument errors in one process:

l, t	Compensator longitudinal and transversal index errors
i	Vertical index error, related to the standing axis
c	Horizontal collimation error, also called line of sight error
ATR Hz	ATR zero point error for horizontal angle option
ATR V	ATR zero point error for vertical angle option

Combined adjustment procedure step-by-step

The following table explains the most common settings.

Step	Description
1.	**Main Menu**: **User\Check & Adjust**
2.	**Check & Adjust Wizard** Select the option: **Check & adjust the compensator, index error, line of sight error & automatic target aiming**
3.	**Next**
4.	**Face I measurement** If **Calibrate the automatic target aiming** is checked and an ATR is available, the adjustment will include the determination of the ATR Hz and V adjustment errors. ☞ Use a clean Leica standard prism as the target. Do not use a 360° prism.
5.	 Aim the telescope accurately at a target at about 100 m distant. The target must be positioned within ±9°/±10 gon of the horizontal plane. The procedure can be started in any face.
6.	**Meas** to measure and to continue to the next screen.  Motorised instruments change automatically to the other face. Non-motorised instruments guide to the other face. ☞ The fine pointing has to be performed manually in both faces.
7.	**Face II measurement** **Meas** to measure the same target in the other face and to calculate the instrument errors.

Step	Description
☞	If one or more errors are bigger than the predefined limits, the procedure must be repeated. All measurements of the current run are rejected and none of them is averaged with the results from previous runs.
8.	Adjustment Status **No. of measurements**: Shows the number of runs completed. One run consists of a measurement in face I and face II. **σ I Comp**: and similar lines show the standard deviations of the determined adjustment errors. The standard deviations can be calculated from the second run onwards.
☞	Measure at least two runs.
9.	**Next** to continue with the check & adjust procedure.
10.	Select **Add another calibration loop** if more runs have to be added. **Next** and continue with step *4*. OR Select **Finish the calibration & store the results** to finish the calibration process. **Next** to view the adjustment results.
11.	Select **Finish** to accept the results. No more runs can be added later. OR Select **Redo** to decline all measurements and to repeat all calibration runs. OR **Back** returns to the previous screen.

Next step

IF the results are	THEN
to be stored	If the Use status is set to Yes, **Next** overwrites the old adjustment errors with the new ones.
to be determined again	**Redo** rejects all new determined adjustment errors and repeats the whole procedure. Refer to paragraph "Combined adjustment procedure step-by-step".

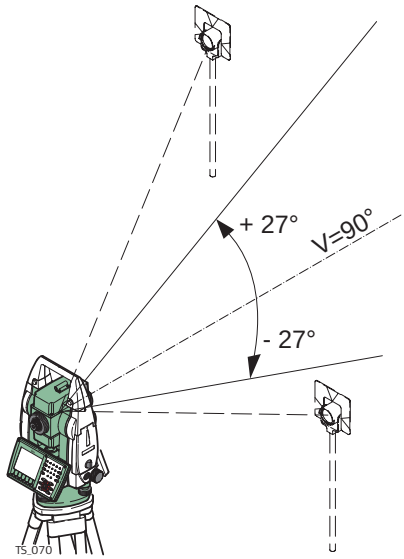
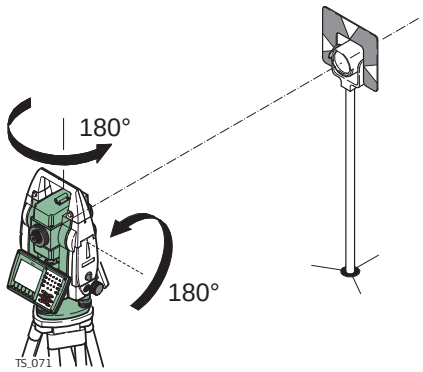
Description

This adjustment procedure determines the following instrument error:

a Tilting axis error

Determination of tilting axis error step-by-step

The following table explains the most common settings.

Step	Description
☞	Determine the horizontal collimation error (c) before starting this procedure.
1.	**Main Menu**: **User\Check & Adjust**
2.	**Check & Adjust Wizard** Select the option: **Check & adjust the tilting axis**
3.	**Face I measurement**  Aim the telescope accurately at a target at about 100 m distance or less if not possible. The target must be positioned at least 27°/30 gon above or beneath the horizontal plane. The procedure can be started in any telescope face.
4.	**Meas** to measure and to continue to the next screen.  Motorised instruments change automatically to the other face. Non-motorised instruments guide to the other face. ☞ The fine pointing must be performed manually in both faces.
5.	**Face II measurement** **Meas** to measure the same target in the other face and to calculate the tilting axis error.
☞	If the error is bigger than the predefined limit, the procedure must be repeated. The tilting axis measurements of the current run are then rejected and not averaged with the results from previous runs.
6.	Adjustment Status **No. of measurements**: Shows the number of runs completed. One run consists of a measurement in face I and face II.

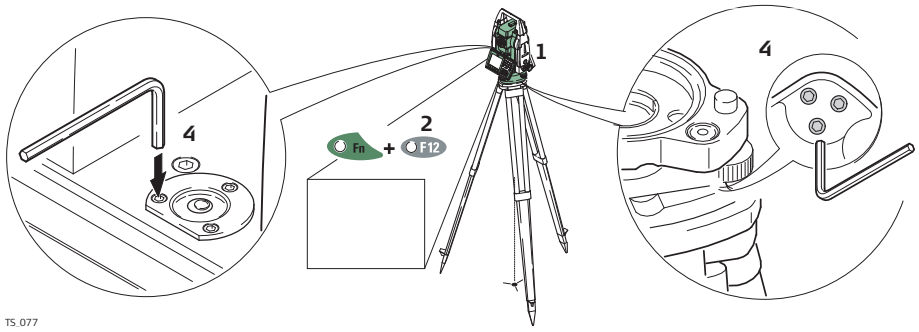
Step	Description
	σ a T-axis: shows the standard deviation of the determined tilting axis error. The standard deviation can be calculated from the second run onwards.
☞	Measure at least two runs.
7.	**Next** to continue with the check & adjust procedure.
8.	Select **Add another calibration loop** if more runs have to be added. **Next** and continue with step 3. OR Select **Finish the calibration & store the results** to finish the calibration process. No more runs can be added later. **Next** to view the adjustment results.
9.	Select **Finish** to accept the results. No more runs can be added later. OR Select **Redo** to decline all measurements and to repeat all calibration runs.

Next step

IF the results are	THEN
to be stored	**Next** overwrites the old tilting axis error with the new one.
to be determined again	**Redo** rejects the new determined tilting axis error and repeats the whole procedure. Refer to paragraph "Determination of tilting axis error step-by-step".

5.5 Adjusting the Circular Level of the Instrument and Tribrach

Adjusting the circular level step-by-step

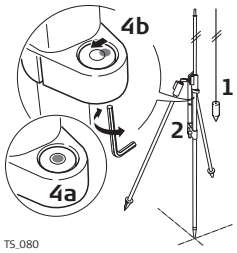


Step	Description
1.	Place and secure the instrument into the tribrach and onto a tripod.
2.	Using the tribrach footscrews, level the instrument with the electronic level.
3.	Select **Instrument\TPS settings\Level bubble & compensator** to access the **Level Bubble & Compensator** screen.
4.	Check the position of the circular level on the instrument and tribrach.
5.	a) If both circular levels are centred, no adjustments are necessary
	b) If one or both circular levels are not centred, adjust as follows:
	Instrument: If it extends beyond the circle, use the supplied allen key to centre it with the adjustment screws. Turn the instrument by 200 gon (180°). Repeat the adjustment procedure if the circular level does not stay centred.
	Tribrach: If it extends beyond the circle, use the supplied allen key to centre it with the adjustment screws.
☞	After the adjustments, all adjusting screws must have the same tightening tension and no adjusting screw should be loose.

5.6 Adjusting the Circular Level of the Prism Pole

Adjusting the circular level step-by-step

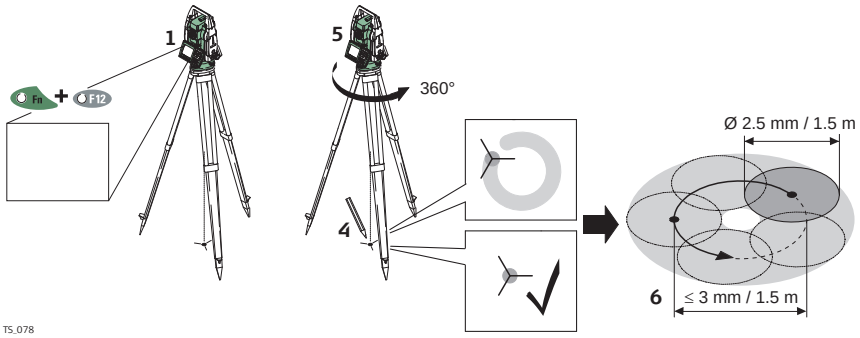
Step	Description
1.	Suspend a plumb line.
2.	Use a pole bipod, to align the prism pole parallel to the plumb line.
3.	Check the position of the circular level on the prism pole.
4.	a) If the circular level is centred, no adjustment is necessary.
	b) If the circular level is not centred, use an allen key to centre it with the adjustment screws.
☞	After the adjustments, all adjusting screws must have the same tightening tension and no adjusting screw should be loose.



5.7 Inspecting the Laser Plummet of the Instrument

☞ The laser plummet is located in the vertical axis of the instrument. Under normal conditions of use, the laser plummet does not need adjusting. If an adjustment is necessary due to external influences, return the instrument to any Leica Geosystems authorised service workshop.

Inspecting the laser plummet step-by-step



The following table explains the most common settings.

Step	Description
1.	Place and secure the instrument into the tribrach and onto a tripod.
2.	Using the tribrach footscrews, level the instrument with the electronic level.
3.	Select **Instrument\TPS settings\Level bubble & compensator** to access the **Level Bubble & Compensator** screen.
4.	The laser plummet is switched on when the **Level Bubble & Compensator** screen is entered. Adjust the laser plummet intensity. Inspection of the laser plummet should be carried out on a bright, smooth and horizontal surface, like a sheet of paper.
5.	Mark the centre of the red dot on the ground.
6.	Turn the instrument through 360° slowly, carefully observing the movement of the red laser dot.
☞	The maximum diameter of the circular movement described by the centre of the laser point must not exceed 3 mm at a distance of 1.5 m.
7.	If the centre of the laser dot describes a perceptible circular movement, or moves more than 3 mm away from the point which was first marked, an adjustment may be required. Inform your nearest Leica Geosystems authorised service workshop. Depending on brightness and surface, the diameter of the laser dot can vary. At 1.5 m, it is about 2.5 mm.

5.8 Adjusting the Laser Guide

☞ To avoid moisture or dust entering the Laser Guide compartment, adjustment screws and screw covers must be fixed after each adjustment procedure.

Adjustment

The recommended adjustment procedure is designed for distances of 50 m and 120 m. Use the adjustment drawing, which is showing a TS15 G telescope, with cross-hairs for line of sight and Laser Guide. Look trough the telescope and aim to the cross-hairs of the telescope. For well-adjusted Laser Guides, the laser beam should exactly match the circles for 50/120 m.

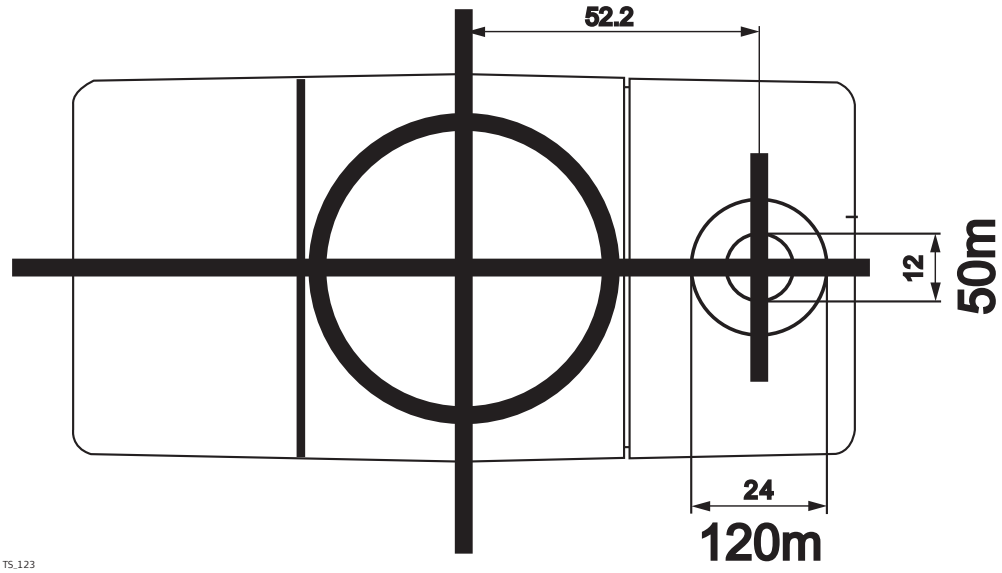
☞ Make sure, adjustment screws are accessible during adjustment.

☞ Make sure, the position of the telescope remains still. Check the target by looking trough the telescope.

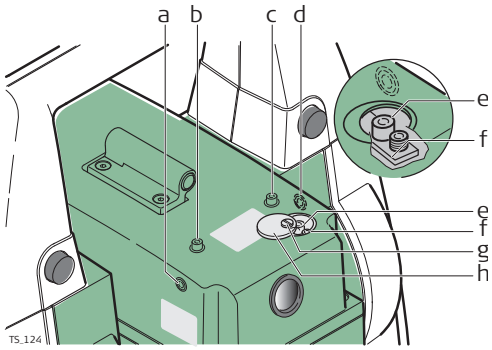
☞ Adjustment procedure might be repeated to achieve high precision adjustment.

Adjustment

Please enlarge this target plate to 200% prior to using it for adjustment.



Laser guide screws



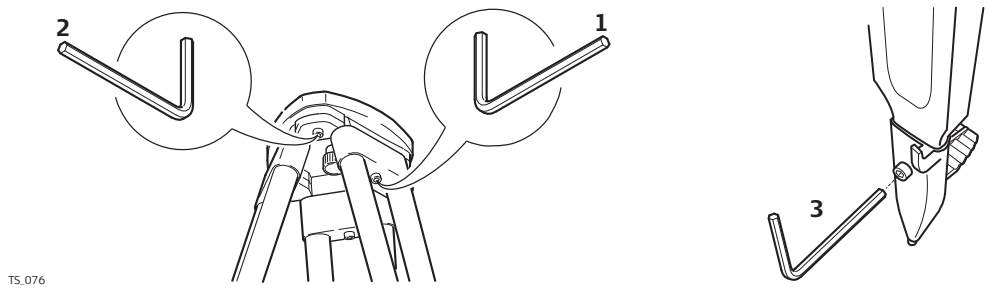
a) Horizontal adjustment screw
b) Fixing screw
c) Fixing screw
d) Horizontal adjustment screw
e) Vertical adjustment screw
f) Vertical adjustment screw
g) Safety cover screw
h) Safety cover

Laser Guide adjustment step-by-step

This step-by-step description describes the Laser Guide adjustment for a distance of 50 m. Place the target plate at a distance of 120 m to perform the laser guide adjustment for 120 m.

Step	Description
☞	Make sure that the instrument is levelled.
1.	Place the laser guide target plate at a distance of 50 m and aim with the telescope of the instrument at the crosshairs of the target plate.
2.	Loosen the safety cover screw (g) and move the safety cover (h) to the side to access the vertical adjustment screws.
3.	Loosen the vertical adjustment screws (e) and (f). Do not fully remove the screws.
4.	Loosen the fixing screws (b) and (c) as little as the spring force remains.
5.	**Horizontal adjustment:** To adjust the laser guide to the left, loosen the horizontal adjustment screw (d). Tighten the horizontal adjustment screw (a) as much as to move the laser beam slightly left of the upper crosshairs on the target plate.
6.	To adjust the laser guide to the right, loosen the horizontal adjustment screw (a). Tighten the horizontal adjustment screw (d) as much as to move the laser beam slightly right of the upper crosshairs on the target plate.
7.	Fix the horizontal adjustment by tightening the opposite horizontal adjustment screw either (a) or (d). ☞ Fixing the opposite screw moves the laser beam exactly to the vertical crosshair.
8.	Finish the horizontal adjustment by tightening the fixing screws (b) and (c).
9.	**Vertical adjustment:** Loosen the vertical adjustment screw (e) as much as to move the laser beam slightly upon of the upper crosshairs on the target plate.
10.	Fix the vertical adjustment by tightening the vertical adjustment screw (f). ☞ Fixing this screw moves the laser beam exactly to the crosshairs centre.
11.	Finish the vertical adjustment by moving the safety cover (h) to its original position and by tightening the safety cover screw (g).
☞	The laser beam of an adjusted laser guide matches exactly the circle of 50 m or 120 m depending on the distance.

Servicing the tripod step-by-step



The following table explains the most common settings.

Step	Description
☞	The connections between metal and timber components must always be firm and tight.
1.	Tighten the leg cap screws moderately, with the supplied allen key.
2.	Tighten the articulated joints on the tripod head enough to keep the tripod legs open when lifting the tripod off the ground.
3.	Tighten the allen screws of the tripod legs.

6 Care and Transport

6.1 Transport

Transport in the field	When transporting the equipment in the field, always make sure that you • either carry the product in its original transport container, • or carry the tripod with its legs splayed across your shoulder, keeping the attached product upright.
Transport in a road vehicle	Never carry the product loose in a road vehicle, as it can be affected by shock and vibration. Always carry the product in its transport container, original packaging or equivalent and secure it.
Shipping	When transporting the product by rail, air or sea, always use the complete original Leica Geosystems packaging, transport container and cardboard box, or its equivalent, to protect against shock and vibration.
Shipping, transport of batteries	When transporting or shipping batteries, the person in charge of the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping, contact your local passenger or freight transport company.
Field adjustment	Periodically carry out test measurements and perform the field adjustments indicated in the User Manual, particularly after the product has been dropped, stored for long periods or transported.

6.2 Storage

Product	Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to "Technical Data" for information about temperature limits.
Field adjustment	After long periods of storage inspect the field adjustment parameters given in this user manual before using the product.
Li-Ion batteries	• Refer to "Technical Data" for information about storage temperature range. • Remove batteries from the product and the charger before storing. • After storage recharge batteries before using. • Protect batteries from damp and wetness. Wet or damp batteries must be dried before storing or use. • A storage temperature range of 0°C to +30°C / +32°F to +86°F in a dry environment is recommended to minimize self-discharging of the battery. • At the recommended storage temperature range, batteries containing a 40% to 50% charge can be stored for up to one year. After this storage period the batteries must be recharged.

6.3 Cleaning and Drying

Product and accessories

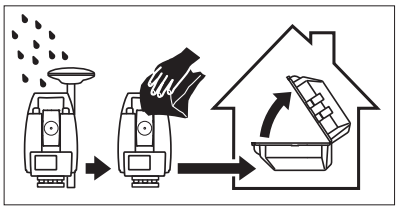
- Blow dust off lenses and prisms.
- Never touch the glass with your fingers.
- Use only a clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with water or pure alcohol. Do not use other liquids; these can attack the polymer components.

Fogging of prisms

Prisms that are cooler than the ambient temperature tend to fog. It is not enough simply to wipe them. Keep them for some time inside your jacket or in the vehicle to allow them to adjust to the ambient temperature.

Damp products

Dry the product, the transport container, the foam inserts and the accessories at a temperature not greater than 40°C /104°F and clean them. Remove the battery cover and dry the battery compartment. Do not repack until everything is completely dry. Always close the transport container when using in the field.



Cables and plugs

Keep plugs clean and dry. Blow away any dirt lodged in the plugs of the connecting cables.

6.4 Maintenance

Motorisation

An inspection of the motorisation in motorised instruments must be done in a Leica Geosystems authorised service workshop.
Following conditions:

- After about 4000 hours operation.
- Twice a year in case of permanent use of the instrument, for example in monitoring applications.

7 Technical Data

7.1 Angle Measurement

Accuracy

Available angular accuracies	Standard deviation Hz, V, ISO 17123-3	Display resolution			
["]	[mgon]	["]	[°]	[mgon]	[mil]
1	0.3	0.1	0.0001	0.1	0.01
2	0.6	1	0.0001	0.1	0.01
3	1.0	1	0.0001	0.1	0.01
5	1.5	1	0.0001	0.1	0.01

Characteristics

Absolute, continuous, diametric.

7.2 Distance Measurement with Reflectors

Range

Reflector	Range A		Range B		Range C	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
Standard prism (GPR1)	1800	6000	3000	10000	3500	12000
Three standard prisms (GPR1)	2300	7500	4500	14700	5400	17700
360° prism (GRZ4, GRZ122)	800	2600	1500	5000	2000	7000
360° Mini prism (GRZ101)	450	1500	800	2600	1000	3300
Mini prism (GMP101)	800	2600	1200	4000	2000	7000
Reflector tape (GZM31) 60 mm x 60 mm	150	500	250	800	250	800
Machine Automation power prism (MPR122) ☞ For Machine Control purposes only!	800	2600	1500	5000	2000	7000

Shortest measuring distance: 1.5 m

Atmospheric conditions

Range A: Strong haze, visibility 5 km; or strong sunlight, severe heat shimmer
Range B: Light haze, visibility about 20 km; or moderate sunlight, slight heat shimmer
Range C: Overcast, no haze, visibility about 40 km; no heat shimmer

☞ Measurements can be made to reflector tapes over the entire range without external ancillary optics.

Accuracy

Accuracy refers to measurements to standard prisms.

EDM measuring mode	std. dev. ISO 17123-4, standard prism	std. dev. ISO 17123-4, tape	Measurement time, typical [s]
Standard	1 mm + 1.5 ppm	3 mm + 2 ppm	2.4
Single (fast)	2 mm + 1.5 ppm	3 mm + 2 ppm	0.8
Continuous	3 mm + 1.5 ppm	3 mm + 2 ppm	< 0.15

Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy.
The display resolution is 0.1 mm.

Characteristics

Principle: Phase measurement
Type: Coaxial, visible red laser
Carrier wave: 658 nm
Measuring system: System analyser basis 100 MHz - 150 MHz

7.3 Distance Measurement without Reflectors

Range

Type	Kodak Gray Card	Range D		Range E		Range F	
		[m]	[ft]	[m]	[ft]	[m]	[ft]
R400	White side, 90 % reflective	200	660	300	990	>400	>1310
R400	Grey side, 18 % reflective	150	490	200	660	>200	>660
R1000	White side, 90 % reflective	800	2630	1000	3280	>1000	>3280
R1000	Grey side, 18 % reflective	400	1320	500	1640	>500	>1640

☞ R30 is able to achieve a range of 30 m/100 ft under all atmospheric conditions (D, E, F).

Range of Measurement: 1.5 m - 1200 m
Display unambiguous: up to 1200 m

Atmospheric conditions

D: Object in strong sunlight, severe heat shimmer
E: Object in shade, sky overcast
F: Underground, night and twilight

Accuracy

Standard measuring	std. dev. ISO 17123-4	Measure time, typical [s]	Measure time, maximum [s]
0 m - 500 m	2 mm + 2 ppm	3 - 6	12
>500 m	4 mm + 2 ppm	3 - 6	12

Object in shade, sky overcast. Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy. The display resolution is 0.1 mm.

Characteristics

Type: Coaxial, visible red laser
Carrier wave: 658 nm
Measuring system: System analyser basis 100 MHz - 150 MHz

Laser dot size

Distance [m]	Laser dot size, approximately [mm]
at 30	7 x 10
at 50	8 x 20
at 100	16 x 25

7.4 Distance Measurement - Long Range (LO mode)

Range

The range of the long range measurements is the same for R400 and R1000.

Reflector	Range A		Range B		Range C	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
Standard prism (GPR1)	2200	7300	7500	24600	>10000	>33000

Range of measurement: 1000 m to 12000 m
Display unambiguous: up to 12000 m

Atmospheric conditions

Range A: Strong haze, visibility 5 km; or strong sunlight, severe heat shimmer
Range B: Light haze, visibility about 20 km; or moderate sunlight, slight heat shimmer
Range C: Overcast, no haze, visibility about 40 km; no heat shimmer

Accuracy

Standard measuring	std. dev. ISO 17123-4	Measure time, typical [s]	Measure time, maximum [s]
Long Range	5 mm + 2 ppm	2.5	12

Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy. The display resolution is 0.1 mm.

Characteristics

Principle: Phase measurement
Type: Coaxial, visible red laser
Carrier wave: 658 nm
Measuring system: System analyser basis 100 MHz - 150 MHz

7.5 Automatic Target Aiming ATR

Range ATR/LOCK

Reflector	Range ATR mode		Range Lock mode	
	[m]	[ft]	[m]	[ft]
Standard prism (GPR1)	1000	3300	800	2600
360° prism (GRZ4, GRZ122)	800	2600	600	2000
360° Mini prism (GRZ101)	350	1150	200	660
Mini prism (GMP101)	500	1600	400	1300
Reflector tape 60 mm x 60 mm	45	150	not qualified	
Machine Automation power prism (MPR122) ☞ For Machine Control purposes only!	600	2000	500	1600
☞ The maximum range can be restricted by poorer conditions, for example rain.				

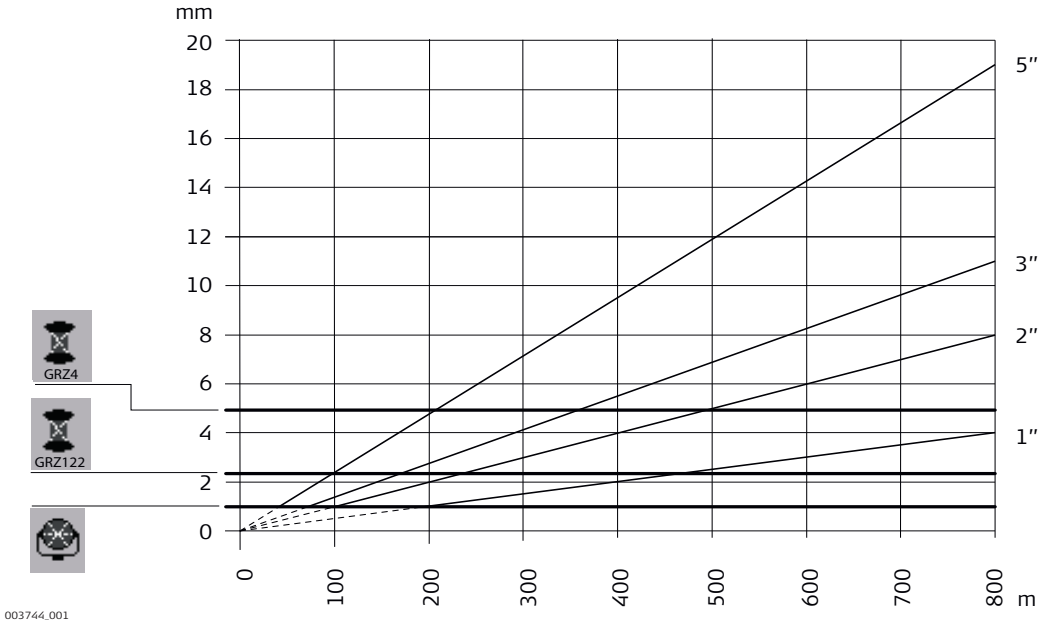
Shortest measuring distance: 360° prism ATR: 1.5 m
Shortest measuring distance: 360° prism LOCK: 5 m

ATR accuracy with the GPR1 prism

ATR angle accuracy Hz, V (std. dev. ISO 17123-3): 1 " (0.3 mgon)
Base Positioning accuracy (std.dev.): ± 1 mm

System accuracy with ATR

- The accuracy with which the position of a prism can be determined with Automatic Target Aiming (ATR) depends on several factors such as internal ATR accuracy, instrument angle accuracy, prism type, selected EDM measuring program and the external measuring conditions. The ATR has a basic standard deviation level of ± 1 mm. Above a certain distance, the instrument angle accuracy predominates and takes over the standard deviation of the ATR.
- The following graph shows the ATR standard deviation based on three different prism types, distances and instrument accuracies.



Leica GRZ4 prism (360°)

Leica GRZ122 prism (360°)

Leica circular prisms and Leica circular Mini prisms

mm ATR accuracy [mm]

m Distance measurement [m]

" Instrument angle accuracy ["]

Maximum speed in lock mode

Maximum tangential speed:	5 m/s at 20 m; 25 m/s at 100 m
Maximum radial speed with **Measure mode**: **Continuous**	5 m/s

Searching

Typical search time in field of view:	1.5 s
Field of view:	1°25′/1.55 gon
Definable search windows:	Yes

Characteristics

Principle:	Digital image processing
Type:	Infrared laser

7.6 PowerSearch PS

Range

Reflector	Range PS	
	[m]	[ft]
Standard prism (GPR1)	300	1000
360° prism (GRZ4, GRZ122)	300*	1000*
Mini prism (GMP101)	100	330
Machine Automation power prism (MPR122) ☞ For Machine Control purposes only!	300*	1000*

Measurements at the vertical limits of the fan or under unfavourable atmospheric conditions may reduce the maximum range. (*optimally aligned to the instrument)

Shortest measuring distance: 1.5 m

Searching

Typical search time:	‹ 10 s
Default search area:	Hz: 400 gon, V: 40 gon
Definable search windows:	Yes

Characteristics

Principle:	Digital signal processing
Type:	Infrared laser

7.7 Overview Camera

Overview camera

Sensor:	5 Mpixel CMOS sensor
Focal length:	21 mm
Field of view:	15.5° x 11.7° (19.4° diagonal)
Frame rate:	≤20 frames per second
Focus:	2 m (6.6 ft) to infinity at zoom level 1 x 7.5 m (24.6 ft) to infinity at zoom level 4 x
Image storage:	JPEG up to 5 Mpixel (2560 x 1920)
Zoom:	4-step (1x, 2x, 4x, 8x)
Whitebalance:	Automatic and user configurable
Brightness:	Automatic and user configurable

7.8 SmartStation

7.8.1 SmartStation Accuracy

Measurement precision and accuracy in position and accuracy in height are dependent upon various factors including the number of satellites tracked, constellation geometry, observation time, ephemeris accuracy, ionospheric disturbance, multipath and resolved ambiguities. Figures quoted assume normal to favourable conditions.

Accuracy

Position accuracy:	Horizontal: 5 mm + 0.5 ppm Vertical: 10 mm + 0.5 ppm When used within reference station networks the position accuracy is in accordance with the accuracy specifications provided by the reference station network.

Initialisation

Method:	Leica SmartCheck+ technology
Reliability of initialisation:	Better than 99.99 %
Time of initialisation:	Typically 8 s*
Range:	Up to 50 km*

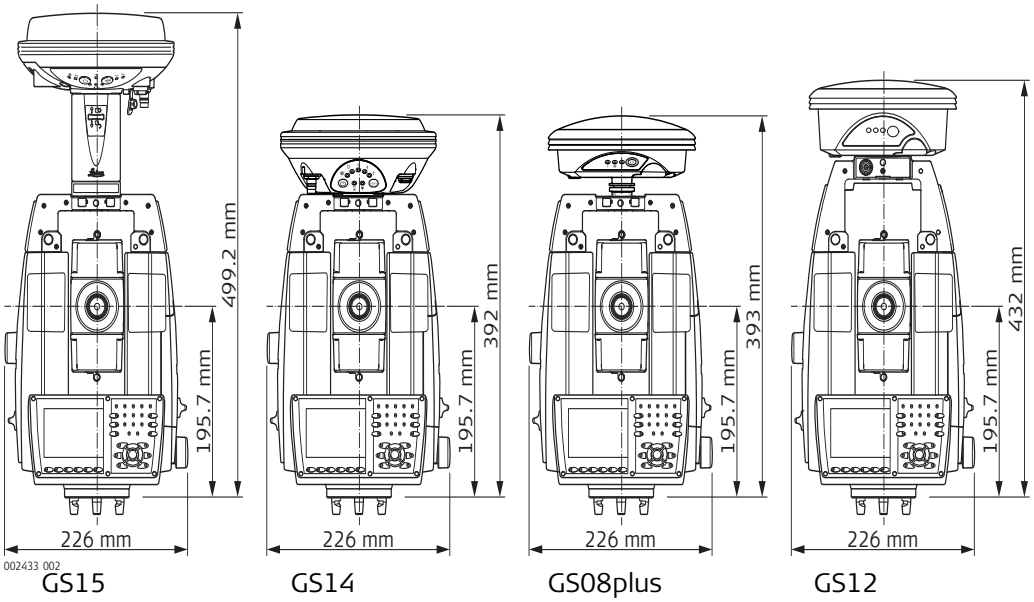
* Might vary due to atmospheric conditions, signal multipath, obstructions, signal geometry and number of tracked signals.

RTK data formats

Formats for data reception: Leica proprietary GPS and GNSS real-time data formats, CMR, CMR+, RTCM V2.1 / 2.2 / 2.3 / 3.1

7.8.2 SmartStation Dimensions

SmartStation Dimensions



7.8.3 SmartAntenna Technical Data

Description and use

The SmartAntenna is selected for use based upon the application. The table gives a description and the intended use of the SmartAntenna.

Type	Description	Use
GS08plus	L1, L2 GPS, GLONASS SmartTrack+ antenna.	With CS10 field controller or Leica Viva TPS instruments.
GS12	L1, L2, L5 GPS, GLONASS, Galileo SmartTrack+ antenna.	With CS10/CS15 field controller or Leica Viva TPS instruments.
GS14	GPS, GLONASS, Galileo, BeiDou SmartTrack+ antenna with built in groundplane.	With CS10/CS15 field controller or Leica Viva TPS instruments.
GS15	GPS, GLONASS, Galileo, BeiDou SmartTrack+ antenna with built in groundplane.	With CS10/CS15 field controller or Leica Viva TPS instruments.

Dimensions

Type	Height [m]	Diameter [m]
GS08plus	0.071	0.186
GS12	0.089	0.186
GS14	0.090	0.190
GS15	0.198	0.196

Mounting

5/8" Whitworth

Weight

Instrument weights without battery and radio:

Type	Weight [kg]/[lbs]
GS08plus	0.70/1.54
GS12	0.94/2.07
GS14	0.93/2.04
GS15	1.34/2.95

Power

Power consumption:
- GS08plus: 2.0 W typically
- GS12: 1.8 W typically
- GS14, radio excluded: 2.0 W typically, 166 mA with external battery, 270 mA with internal battery
- GS15, radio excluded: 3.2 W typically

External supply voltage: Nominal 12 V DC (⎓, GEV71 car battery cable to a 12 V car battery), voltage range 10.5 V-28 V DC

Battery internal

Type:	Li-Ion
Voltage:	7.4 V
Capacity:	GEB211: 2.2 Ah / GEB212: 2.6 Ah
Typical operating time:	GEB211: 5.7 h / GEB212: 6.5 h

Electrical data

Type	GS08plus	GS12	GS14	GS15
Frequency				
GPS L1 1575.42 MHz	✓	✓	✓	✓
GPS L2 1227.60 MHz	✓	✓	✓	✓
GPS L5 1176.45 MHz	-	✓	-	✓
GLONASS L1 1602.5625-1611.5 MHz	✓	✓	✓	✓
GLONASS L2 1246.4375-1254.3 MHz	✓	✓	✓	✓
Galileo E1 1575.42 MHz	-	✓	-	✓
Galileo E5a 1176.45 MHz	-	✓	-	✓
Galileo E5b 1207.14 MHz	-	✓	-	✓
Galileo Alt-BOC 1191.795 MHz	-	✓	-	✓
Gain	37 dBi	Typically 27 dBi	27 dBi	Typically 27 dBi
Noise Figure	< 3 dBi	Typically < 2 dBi	< 2 dBi	Typically < 2 dBi

☞ Galileo Alt-BOC covers bandwidth of Galileo E5a and E5b.

Environmental specifications

Temperature

Operating temperature [°C]	Storage temperature [°C]
-40 to +65 Bluetooth: -30 to +65	-40 to +80

Protection against water, dust and sand

Protection	
GS08plus/GS12/GS15	**GS14**
IP67 (IEC 60529)	IP68 (IEC 60529)
Dusttight	Dusttight
Protected against water jets	Protected against continuous immersion in water
Waterproof to 1 m temporary immersion	Tested for 2 hours in 1.40 m depth

Humidity

Protection
Up to 100 % The effects of condensation are to be effectively counteracted by periodically drying out the antenna.

7.9 Laser Guide Technical Data

Concept

- Telescope for dual face measurement
- User adjustment for laser beam

Laser

Type:	Visible, red, laser class 3R
Carrier wave:	657 nm

Optics

Line of sight offset:	52.20 mm
Focussing distance:	22.76 mm
Beam angle:	0.09 mrad

Power

Power supply:	From instrument
Power consumption:	ca. 0.2 W

Environmental specifications

Temperature

Operating temperature [°C]	Storage temperature [°C]
-20 to +50	-40 to +70

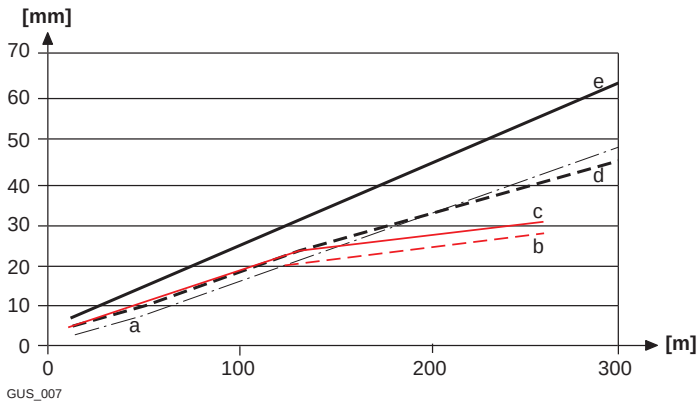
Range

Daylight:	250 m
Darkness:	500 m

Beam diameter

The laser beam diameter is influenced by the intensity of the laser guide, by the application distance, by the characteristics of the surface and by the ambient light.

Typical laser beam diameter on white, smooth surfaces with intensity 50% and 100%



a) Theoretical $1/e^2$
b) Daylight, intensity 50%
c) Daylight, intensity 100%
d) Darkness, intensity 50%
e) Darkness, intensity 100%

7.10 Conformity to National Regulations

7.10.1 TS15

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product TS15 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity may be consulted at http://www.leica-geosystems.com/ce.

CE Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EU Member state.

- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

2402 - 2480 MHz

Output power

Bluetooth:	5 mW

Antenna

Type:	Internal Microstrip antenna
Gain:	1.5 dBi

7.10.2 RadioHandle

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the RadioHandle is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity may be consulted at http://www.leica-geosystems.com/ce.

CE Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA Member state.

- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

RH15	Limited to 2402 - 2452 MHz
RH16	Limited to 2402 - 2480 MHz

Output power

< 100 mW (e. i. r. p.)

Antenna

Type:	λ/2 dipole antenna
Gain:	2 dBi
Connector:	Special customized SMB

Conformity to national regulations

- FCC Part 15, 22 and 24 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product GS08plus is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.

Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.

- The conformity for countries with other national regulations not covered by the FCC part 15, 22 and 24 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

Type	Frequency band [MHz]
GS08plus	1227.60 1575.42 1246.4375 - 1254.3 1602.4375 - 1611.5
Bluetooth	2402 - 2480

Output power

Type	Output power [mW]
GNSS	Receive only
Bluetooth	5 (Class 1)

Antenna

GNSS Bluetooth	Internal GNSS antenna element (receive only) Type: Internal Microstrip antenna Gain: 1.0 dBi

Conformity to national regulations

- FCC Part 15, 22 and 24 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product GS12 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.

CE Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.

- The conformity for countries with other national regulations not covered by the FCC part 15, 22 and 24 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

Type	Frequency band [MHz]
GS12	1176.45 1191.795 1207.14 1227.60 1246.4375 - 1254.3 1575.42 1602.4375 - 1611.5
Bluetooth	2402 - 2480

Output power

Type	Output power [mW]
GNSS	Receive only
Bluetooth	5 (Class 1)

Antenna

GNSS Bluetooth	Internal GNSS antenna element (receive only) Type: Internal Microstrip antenna Gain: 1.5 dBi

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product GS14 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.
- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.

Class 2 equipment according European Directive 1999/5/EC (R&TTE) for which following EEA Member States apply restrictions on the placing on the market or on the putting into service or require authorisation for use:
  - France
  - Italy
  - Norway (if used in the geographical area within a radius of 20km from the centre of Ny-Ålesund)
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance (applicable for Japan).
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

Type	Frequency band [MHz]
GS14	1227.60 1246.4375 - 1254.3 1575.42 1602.5625 - 1611.5
GS14, Bluetooth	2402 - 2480
GS14, Radio	403 - 473
GS14, 2G GSM	Quad-Band EGSM 850 / 900 / 1800 / 1900
GS14, 3.75G GSM/UMTS	Quad-Band GSM & Penta-Band 800 / 850 / 900 / 1900 / 2100
GS14, 3.75G/CDMA GSM/UMTS/CDMA	Quad-Band GSM & Penta-Band UMTS & Tri-Band CDMA 800 / 850 / 1900

Output power

Type	Output power [mW]
GNSS	Receive only
Bluetooth	5
Radio	1000
2G GSM EGSM850/900	2000
2G GSM GSM1800/1900	1000
2G GSM	GPRS multi-slot class 10 (max. 2/8 TX)
3.75G GSM	E(dge)GPRS multi-slot class 12 (max. 4/8 TX)
3.75G UMTS 800/850/900/1900/2100	250
CDMA BC0 (800/850) / BC1 (1900)	250

Antenna

Type	Antenna	Gain [dBi]
GNSS	Internal GNSS antenna element (receive only)	-
Bluetooth	Internal Microstrip antenna	2 max.
UHF	External antenna	-
GSM/UMTS/CDMA	Integrated antenna	0 max. @ 800 / 850 / 900 3 max. @ 1800 / 1900 / 2100

7.10.6 GS15

Conformity to national regulations

- FCC Part 15, 22 and 24 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product GS15 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.

CE Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.

- The conformity for countries with other national regulations not covered by the FCC part 15, 22 and 24 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance (applicable for Japan).
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

Type	Frequency band [MHz]
GS15	1176.45 1191.795 1207.14 1227.60 1246.4375 - 1254.3 1575.42 1602.4375 - 1611.5
Bluetooth	2402 - 2480

Output power

Type	Output power [mW]
GNSS	Receive only
Bluetooth	5 (Class 1)

Antenna

Type	Antenna	Gain [dBi]	Connector	Frequency band [MHz]
GNSS	Internal GNSS antenna element (receive only)	-	-	-
Bluetooth	Internal Microstrip antenna	1.5	-	-

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product SLR1, SLR2 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.
- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.

Class 2 equipment according European Directive 1999/5/EC (R&TTE) for which following EEA Member States apply restrictions on the placing on the market or on the putting into service or require authorisation for use:
  - France
  - Italy
  - Norway (if used in the geographical area within a radius of 20km from the centre of Ny-Ålesund)
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

403 MHz - 470 MHz

Output power

SLR1: 0.5 W-1.0 W
SLR2: Receive only

Antenna

Type	Internal	GAT1	GAT2
Frequency band [MHz]	400 - 470	400 - 435	435 - 470
Type	Internal	Detachable λ/2 antenna	Detachable λ/2 antenna
Connector	-	TNC	TNC

Specific Absorption Rate (SAR)

The product meets the limits for the maximum permissible exposure of the guide-lines and standards which are force in this respect. The product must be used with the recommended antenna. A separation distance of at least 20 centimetres should be kept between the antenna and the body of the user or nearby person within the intended application.

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product SLR5 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.
- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.

Class 2 equipment according European Directive 1999/5/EC (R&TTE) for which following EEA Member States apply restrictions on the placing on the market or on the putting into service or require authorisation for use:
  - France
  - Italy
  - Norway (if used in the geographical area within a radius of 20km from the centre of Ny-Ålesund)
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

403 MHz - 470 MHz

Output power

SLR5: 0.5 W-1.0 W

Antenna

Type	Internal	GAT1	GAT2
Frequency band [MHz]	400 - 470	400 - 435	435 - 470
Type	Internal	Detachable λ/2 antenna	Detachable λ/2 antenna
Connector	-	TNC	TNC

Specific Absorption Rate (SAR)

The product meets the limits for the maximum permissible exposure of the guide-lines and standards which are force in this respect. The product must be used with the recommended antenna. A separation distance of at least 20 centimetres should be kept between the antenna and the body of the user or nearby person within the intended application.

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product SLR3-1, SLR3-2 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.
- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.

Class 2 equipment according European Directive 1999/5/EC (R&TTE) for which following EEA Member States apply restrictions on the placing on the market or on the putting into service or require authorisation for use:
  - France
  - Italy
  - Norway (if used in the geographical area within a radius of 20km from the centre of Ny-Ålesund)
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

SLR3-1:	390 MHz - 430 MHz
SLR3-2:	430 MHz - 470 MHz

Output power

SLR3-1:	0.5 W-1 W
SLR3-2:	0.5 W-1 W

Antenna

Type	Internal	GAT1	GAT2
Frequency band [MHz]	400 - 470	400 - 435	435 - 470
Type	Internal	Detachable λ/2 antenna	Detachable λ/2 antenna
Connector	-	TNC	TNC

Specific Absorption Rate (SAR)

The product meets the limits for the maximum permissible exposure of the guide-lines and standards which are force in this respect. The product must be used with the recommended antenna. A separation distance of at least 20 centimetres should be kept between the antenna and the body of the user or nearby person within the intended application.

Conformity to national regulations

- FCC Part 15, 22 and 24 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the SLG1 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity may be consulted at http://www.leica-geosystems.com/ce.

CE Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA Member state.

- The conformity for countries with other national regulations not covered by the FCC part 15, 22 and 24 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

UMTS/HSDPA (WCDMA/FDD) 850 MHz/ 1900 MHz/ 2100 MHz
Quad-Band EGSM 850 MHz/ 900 MHz/ 1800 MHz/ 1900 MHz
GPRS multi-slot class 12
EDGE multi-slot class 12

Output power

EGSM850/900:	2 W
GSM1800/1900:	1 W
UMTS2100:	0.25 W
EDGE850/900:	0.5 W
EDGE1800/1900:	0.4 W

Antenna

Type	GS15 Internal	GAT3	GAT5	GAT18
Frequency band [MHz]	824 - 894 / 890 - 960 / 1710 - 1880 / 1850 - 1990 / 1920 - 2170	890 - 960 / 1710 - 1880 / 1920 - 2170	824 - 894 / 1850 - 1990	824 - 894 / 890 - 960 / 1710 - 1880 / 1850 - 1990 / 1920 - 2170
Type	Internal	Detachable λ/2 antenna	Detachable λ/2 antenna	Detachable λ/2 antenna
Connector	-	TNC	TNC	TNC

Specific Absorption Rate (SAR)

The product meets the limits for the maximum permissible exposure of the guide-lines and standards which are force in this respect. The product must be used with the recommended antenna. A separation distance of at least 20 centimetres should be kept between the antenna and the body of the user or nearby person within the intended application.

Conformity to national regulations

- FCC Part 15, 22 and 24 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the SLG2 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity may be consulted at http://www.leica-geosystems.com/ce.

  CE Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA Member state.
- The conformity for countries with other national regulations not covered by the FCC part 15, 22 and 24 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

Quad-Band EGSM850 MHz/ EGSM900 MHz/ GSM1800 MHz/ GSM1900 MHz

Output power

EGSM850/900: 2 W
GSM1800/1900: 1 W

Antenna

Type	GS15 Internal	GAT3	GAT5	GAT18
Frequency band [MHz]	824 - 894 / 890 - 960 / 1710 - 1880 / 1850 - 1990 / 1920 - 2170	890 - 960 / 1710 - 1880 / 1920 - 2170	824 - 894 / 1850 - 1990	824 - 894 / 890 - 960 / 1710 - 1880 / 1850 - 1990 / 1920 - 2170
Type	Internal	Detachable λ/2 antenna	Detachable λ/2 antenna	Detachable λ/2 antenna
Connector	-	TNC	TNC	TNC

Specific Absorption Rate (SAR)

The product meets the limits for the maximum permissible exposure of the guide-lines and standards which are force in this respect. The product must be used with the recommended antenna. A separation distance of at least 20 centimetres should be kept between the antenna and the body of the user or nearby person within the intended application.

7.10.12 SLC1 (US), SLC2 (US) CDMA Telit CC864-DUAL

Conformity to national regulations

- FCC Part 15, 22 and 24 (applicable in US)
- The conformity for countries with other national regulations not covered by the FCC part 15, 22 and 24 has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

Dual-Band CDMA800 MHz/CDMA1900 MHz

Output power

CDMA800: 0.27 W
CDMA1900: 0.4 W

Antenna

Type	Internal	GAT5	GAT18
Frequency band [MHz]	824 - 894 / 890 - 960 / 1710 - 1880 / 1850 - 1990 / 1920 - 2170	824 - 894 / 1850 - 1990	824 - 894 / 890 - 960 / 1710 - 1880 / 1850 - 1990 / 1920 - 2170
Type	Internal	Detachable λ/2 antenna	Detachable λ/2 antenna
Connector	-	TNC	TNC

Specific Absorption Rate (SAR)

The product meets the limits for the maximum permissible exposure of the guide-lines and standards which are force in this respect. The product must be used with the recommended antenna. A separation distance of at least 20 centimetres should be kept between the antenna and the body of the user or nearby person within the intended application.

7.11 General Technical Data of the Instrument

Telescope

Magnification:	30 x
Free Objective aperture:	40 mm
Focusing:	1.7 m/5.6 ft to infinity
Field of view:	1°30′/1.66 gon. 2.7 m at 100 m

Compensator

Angular accuracy instrument ["]	Setting accuracy		Setting range	
	["]	[mgon]	[']	[gon]
1	0.5	0.2	4	0.07
2	0.5	0.2	4	0.07
3	1.0	0.3	4	0.07
5	1.5	0.5	4	0.07

Level

Circular level sensitivity:	6′/2 mm
Electronic level resolution:	2"

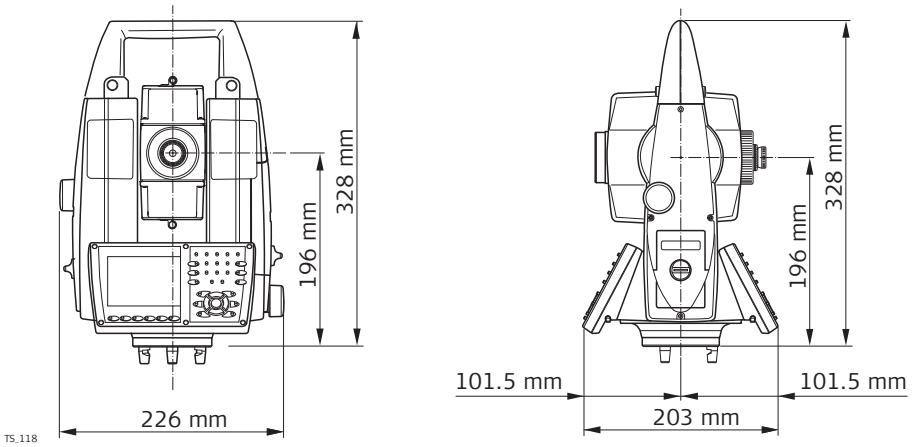
Control unit

Display:	VGA (640 x 480 pixels), color TFT, LED backlight, touch screen
Keyboard:	36 keys including 12 function keys and 12 alphanumeric keys, illumination
Angle Display:	360°′", 360° decimal, 400 gon, 6400 mil, V %
Distance Display:	m, ft int, ft us, ft int inch, ft us inch
Position:	In both faces, face two is optional
Touch screen:	Toughened film on glass

Instrument Ports

Port	Name	Description
Port 1	Port 1	• 5 pin LEMO-0 for power, communication, data transfer. • This port is located at the base of the instrument.
Port 2	Handle	• Hotshoe connection for RadioHandle and SmartAntenna Adapter with SmartStation. • This port is located on top of Communication side cover.
Port 3	BT	• Bluetooth module for communication. • This port is housed within Communication side cover.
USB	USB host port	• USB memory stick port for data transfer.
	USB device port	• Cable connections from USB devices for communication and data transfer.

Instrument dimensions



Weight

Instrument:	4.8 - 5.5 kg
Tribrach:	0.8 kg
Internal battery:	0.2 kg

Recording

Data can be recorded onto an SD card or into internal memory.

Type	Capacity [MB]	Number of measurements per MB
SD card	• 1024 • 8192	1750
Internal memory	• 1000	1750

Laser plummet

Type:	Visible red laser class 2
Location:	In standing axis of instrument
Accuracy:	Deviation from plumb line: 1.5 mm (2 sigma) at 1.5 m instrument height
Diameter of laser point:	2.5 mm at 1.5 m instrument height

Drives

Type:	Endless horizontal and vertical drives

Motorisation

Maximum rotating speed:	50 gon/s

Power

External supply voltage:	Nominal voltage 12.8 V DC, Range 11.5 V-13.5 V

Internal battery

Type:	Li-Ion
Voltage:	7.4 V
Capacity:	GEB221: 4.4 Ah GEB222: 6.0 Ah

External battery

Type:	NiMH
Voltage:	12 V
Capacity:	GEB171: 9.0 Ah

Environmental specifications

Temperature

Type	Operating temperature [°C]	Storage temperature [°C]
All instruments	-20 to +50	-40 to +70
Leica SD cards	-40 to +80	-40 to +80
Battery internal	-20 to +55	-40 to +70
Bluetooth	-30 to +60	-40 to +80

Protection against water, dust and sand

Type	Protection
All instruments	IP55 (IEC 60529)

Humidity

Type	Protection
All instruments	Max 95 % non condensing The effects of condensation are to be effectively counteracted by periodically drying out the instrument.

Reflectors

Type	Additive Constant [mm]	ATR	PS
Standard prism, GPR1	0.0	yes	yes
Mini prism, GMP101	+17.5	yes	yes
360° prism, GRZ4 / GRZ122	+23.1	yes	yes
360° Mini prism, GRZ101	+30.0	yes	not recommended
Reflector tape S, M, L	+34.4	yes	no
Reflectorless	+34.4	no	no
Machine Automation power prism, MPR122 ☞ For Machine Control purposes only!	+28.1	yes	yes

There are no special prisms required for ATR or for PS.

Electronic Guide Light EGL

Working range: 5 m to 150 m (15 ft to 500 ft)
Position accuracy: 5 cm at 100 m (1.97" at 330 ft)

Automatic corrections

The following automatic corrections are made:

- Line of sight error
- Tilting axis error
- Earth curvature
- Circle eccentricity
- Compensator index error
- Vertical index error
- Standing axis tilt
- Refraction
- ATR zero point error

7.12 Scale Correction

Use of scale correction

By entering a scale correction, reductions proportional to distance can be taken into account.

- Atmospheric correction.
- Reduction to mean sea level.
- Projection distortion.

Atmospheric correction ΔD1

The slope distance displayed is correct if the scale correction in ppm, mm/km, which has been entered corresponds to the atmospheric conditions prevailing at the time of the measurement.

The atmospheric correction includes:

- Adjustments for air pressure
- Air temperature
- Relative humidity

For highest precision distance measurements, the atmospheric correction should be determined with an accuracy of 1 ppm. The following parameters must be redetermined:

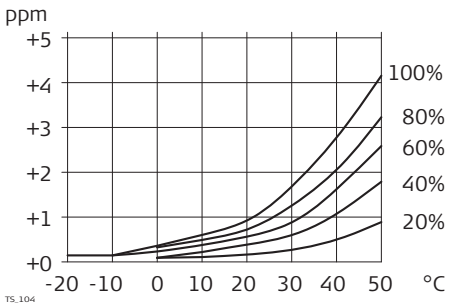
- Air temperature to 1 °C
- Air pressure to 3 mbar
- Relative humidity to 20 %

Air humidity

The air humidity influences the distance measurement if the climate is extremely hot and damp.

For high precision measurements, the relative humidity must be measured and entered along with the air pressure and the temperature.

Air humidity correction



ppmAir humidity correction [mm/km]
% Relative humidity [%]
C° Air temperature [°C]

Index n

Type	Index n	carrier wave [nm]
combined EDM	1.0002863	658

The index n is calculated from the formula of Barrel and Sears, and is valid for:

Air pressure p: 1013.25 mbar
Air temperature t: 12 °C
Relative air humidity h: 60 %

Formulas

Formula for visible red laser

$$\Delta D_1 = 286.34 - \left[\frac{0.29525 \cdot p}{(1 + \alpha \cdot t)} - \frac{4.126 \cdot 10^{-4} \cdot h}{(1 + \alpha \cdot t)} \cdot 10^{x} \right]$$

TS_105

ΔD_1 Atmospheric correction [ppm]
p Air pressure [mbar]
t Air temperature [°C]
h Relative humidity [%]
α $\frac{1}{273.15}$
x $(7.5 * t/(237.3 + t)) + 0.7857$

If the basic value of 60 % relative humidity as used by the EDM is retained, the maximum possible error in the calculated atmospheric correction is 2 ppm, 2 mm/km.

Reduction to mean sea level ΔD_2

The values for ΔD_2 are always negative and are derived from the following formula:

$$\Delta D_2 = - \frac{H}{R} \cdot 10^6$$

TS_106

ΔD_2 Reduction to mean sea level [ppm]
H Height of EDM above sea level [m]
R $6.378 * 10^6$ m

Projection distortion ΔD_3

The magnitude of the projection distortion is in accordance with the projection system used in a particular country, for which official tables are generally available. The following formula is valid for cylindrical projections such as that of Gauss-Krüger:

$$\Delta D_3 = \frac{X^2}{2R^2} \cdot 10^6$$

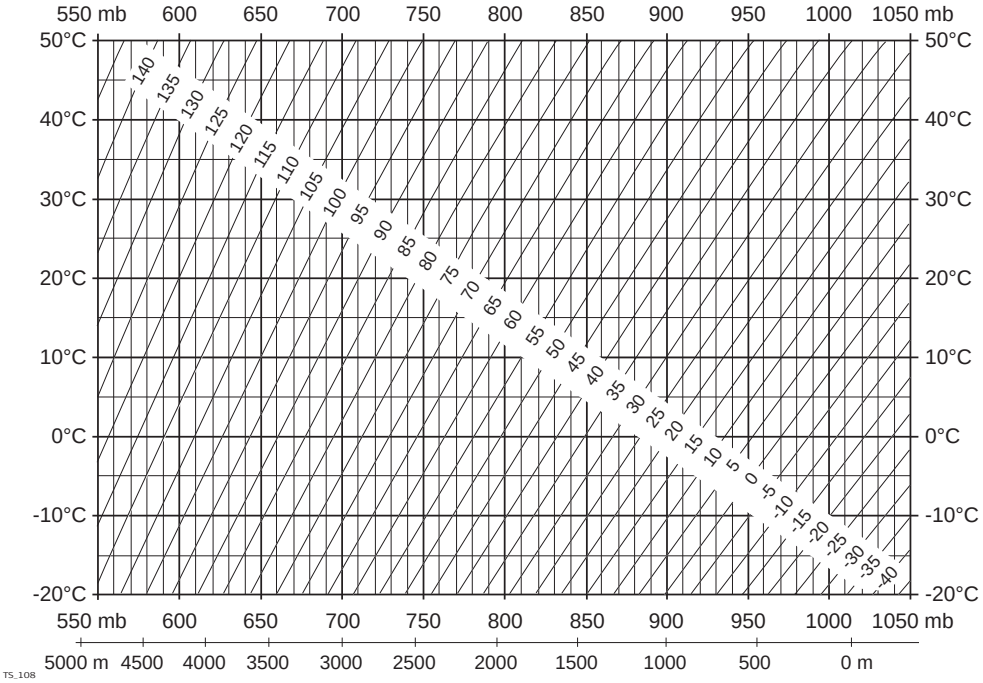
TS_107

ΔD_3 Projection distortion [ppm]
X Easting, distance from projection zero line with the scale factor 1 [km]
R $6.378 * 10^6$ m

In countries where the scale factor is not unity, this formula cannot be directly applied.

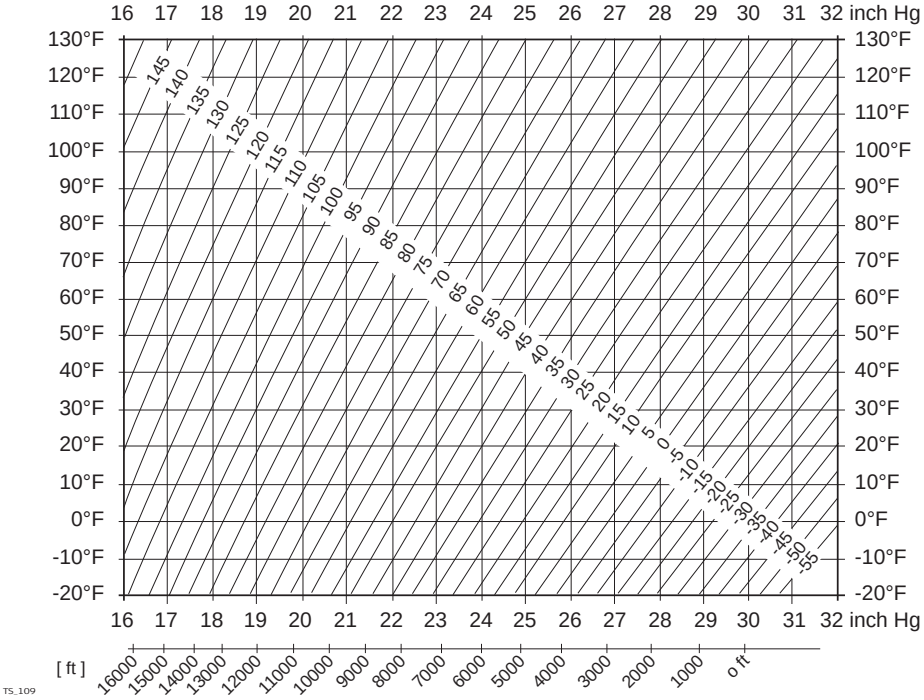
Atmospheric corrections °C

Atmospheric corrections in ppm with temperature [°C], air pressure [mb] and height [m] at 60 % relative humidity.

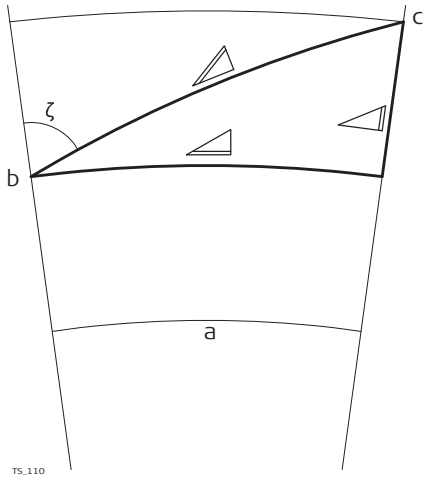


Atmospheric correction °F

Atmospheric corrections in ppm with temperature [°F], air pressure [inch Hg] and height [ft] at 60 % relative humidity.



Measurements



a) Mean Sea Level
b) Instrument
c) Reflector
◿ Slope distance
◿ Horizontal distance
◿ Height difference

Reflector types

The reduction formulas are valid for measurements to all reflector types:

- measurements to prisms, to reflector tape and reflectorless measurements.

Formulas

The instrument calculates the slope distance, horizontal distance, height difference in accordance with the following formulas:

$$\text{◿} = D_0 \cdot (1 + ppm \cdot 10^{-6}) + mm$$
TS_111

◿ Displayed slope distance [m]
D_0 Uncorrected distance [m]
ppmAtmospheric scale correction [mm/km]
mm Additive constant of the reflector [mm]

$$\text{◿} = Y - A \cdot X \cdot Y$$
TS_112

$$\text{◿} = X + B \cdot Y^2$$
TS_113

◿ Horizontal distance [m]
◿ Height difference [m]
Y ◿ * |sinζ|
X ◿ * cosζ
ζ Vertical circle reading
A $(1 - k/2)/R = 1.47 * 10^{-7}$ [m^{-1}]
B $(1 - k)/2R = 6.83 * 10^{-8}$ [m^{-1}]
k 0.13 (mean refraction coefficient)
R $6.378 * 10^6$ m (radius of the earth)

Earth curvature (1/R) and mean refraction coefficient (k) (if enabled on the Refraction page in Main Menu: Config...\Instrument Settings...\TPS Corrections) are automatically taken into account when calculating the horizontal distance and height difference. The calculated horizontal distance relates to the station height and not to the reflector height.

Distance measuring program Averaging

In the distance measuring program Averaging, the following values are displayed:

D Slope distance as arithmetic mean of all measurements
s Standard deviation of a single measurement
n Number of measurements

These values are calculated as follows:

$$\bar{D} = \frac{1}{n} \cdot \sum_{i=1}^{n} D_i$$

TS_114

$\bar{D}$ Slope distance as arithmetic mean of all measurements
$\sum$ Sum
D_i Single slope distance measurement
n Number of measurements

$$s = \sqrt{\frac{\sum_{i=1}^{n} (D_i - \bar{D})^2}{n-1}} = \sqrt{\frac{\sum_{i=1}^{n} D_i^2 - \frac{1}{n} (\sum_{i=1}^{n} D_i)^2}{n-1}}$$

TS_115

s Standard deviation of a single slope distance measurement
$\sum$ Sum
$\bar{D}$ Slope distance as arithmetic mean of all measurements
D_i Single slope distance measurement
n Number of distance measurements

The standard deviation $s_{\bar{D}}$ of the arithmetic mean of the distance can be calculated as follows:

$$s_{\bar{D}} = \frac{s}{\sqrt{n}}$$

TS_116

$s_{\bar{D}}$ Standard deviation of the arithmetic mean of the distance
s Standard deviation of a single measurement
n Number of measurements

8 Software Licence Agreement

Software Licence Agreement

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